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ABSTRACT

The Comprehensive School Mathematics Program (CSMP) is a program of CEMREL, Inc., one of the national educational laboratories, and was funded by the National Institute of Education (NIE). Its major purpose is the development of curriculum materials for kindergarten through grade 6. This document has several goals. The main ones are to summarize CSMP's implementation and to describe the impact of that implementation on adopting school districts. Data on the adoption histories of all sites which used CSMP are presented, the contributions of participants are examined, and the impact of the program is revealed. The material discusses many of the key features of CSMP implementation but at an unfortunately superficial level of detail and generality. The highlights of CSMP history are also provided, primarily with a view towards those who may want to consider adopting the program. The document concludes by noting a generally positive view towards CSMP by teachers in the program, and refers to the current emphasis on mathematics at the national level. Program users are viewed to be in the unique position of currently implementing a curriculum whose time may finally have come. (MP)

ED225864

Extended Pilot Trial of the
Comprehensive School Mathematics Program

Evaluation Report 9-A-2
Summary of Implementation Data
Draft Report

BEST COPY AVAILABLE

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Mathematics Research and Evaluation Studies

November, 1982

CEMREL, Inc.
St. Louis, Mo.

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Description of Evaluation Report Series

The Comprehensive School Mathematics Program (CSMP) is a program of CEMREL,INC., one of the national educational laboratories, and is funded by the National Institute of Education. Its major purpose is the development of curriculum materials for grades K-6.

Beginning in September, 1973, CSMP began an extended pilot trial of its Elementary Program. The pilot trial was longitudinal in nature; students who began using CSMP materials in kindergarten or first grade in 1973-74, were able to use them in first and second grades respectively in 1974-75, and so on in subsequent years. Hence the adjective "extended".

The evaluation of the program in this extended pilot trial was intended to be reasonably comprehensive and to supply information desired by a wide variety of audiences. For that reason the reports in this series are reasonably non-technical and do not attempt to explore widely some of the related issues. The list of reports for previous years is given on the next page.

Final Reports in the series are:

- 9-A-1 Summary of Student Achievement, Draft Report
- 9-A-2 Summary of Implementation Data, Draft Report
- 9-B-1 Sixth Grade MANS Test Data
- 9-C-1 Sixth Grade Evaluation: Teacher Questionnaires

The present report, and report 9-A-2, are summary reports describing results from the full nine-year study covering grades K through 6. As of this time (November, 1982), these two reports are only draft versions and many important issues could not be explored with the care that attended the other 48 volumes of this series.

Extended Pilot Trials of the
Comprehensive School Mathematics Program

Evaluation Report Series

Evaluation Report (1974)	1-A-1	Overview, Design and Instrumentation
	1-A-2	External Review of CSMP Materials
	1-A-3	Final Summary Report Year 1
	1-B-1	Mid-Year Test Data: CSMP First Grade Content
	1-B-2	End-of-Year Test Data: CSMP First Grade Content
	1-B-3	End-of-Year Test Data: Standard First Grade Content
	1-B-4	End-of-Year Test Data: CSMP Kindergarten Content
	1-B-5	Test Data on Some General Cognitive Skills
	1-B-6	Summary Test Data: Detroit Schools
	1-C-1	Teacher Training Report
	1-C-2	Observations of CSMP First Grade Classes
	1-C-3	Mid-Year Data from Teacher Questionnaires
	1-C-4	End-of-Year Data from Teacher Questionnaires
	1-C-5	Interviews with CSMP Kindergarten Teachers
	1-C-6	Analysis of Teacher Logs
Evaluation Report (1975)	2-A-1	Final Summary Report Year 2
	2-B-1	Second Grade Test Data
	2-B-2	Readministration of First Grade Test Items
	2-B-3	Student Interviews
	2-C-1	Teacher Questionnaire Data
	2-C-2	Teacher Interviews, Second Grade
	2-C-3	Teacher Interviews, First Grade
Evaluation Report (1976)	3-B-1	Second and Third Grade Test Data Year 3
	3-C-1	Teacher Questionnaire Data Year 3
Evaluation Report (1977)	4-A-1	Final Summary Report Year 4
	4-B-1	Standardized Test Data, Third Grade
	4-B-2	Mathematics Applied to Novel Situations (MANS) Test Data
	4-B-3	Individually Administered Problems, Third Grade
	4-C-1	Teacher Questionnaire Data, Third Grade
Evaluation Report (1978)	5-B-1	Fourth Grade MANS Test Data
	5-B-2	Individually Administered Problems, Fourth Grade
	5-C-1	Teacher Questionnaire and Interview Data, Fourth Grade
Evaluation Report (1979)	6-B-1	Comparative Test Data: Fourth Grade
	6-B-2	Preliminary Test Data: Fifth Grade
	6-C-1	Teacher Questionnaire Data: Grades 3-5
Evaluation Report (1980)	7-B-1	Fifth Grade Evaluation: Volume I, Summary
	7-B-2	Fifth Grade Evaluation: Volume II, Test Data
	7-B-3	Fifth Grade Evaluation: Volume III, Non-Test Data
	7-B-4	Re-evaluation of Second Grade, Revised MANS Tests
	7-B-5	Achievement of Former CSMP students at Fourth Grade
	7-B-6	Student Achievement, Rapid Implementation Model
Evaluation Report (1981)	8-B-1	Sixth Grade Evaluation, Preliminary Study
	8-B-2	Evaluation of Revised Second Grade, MANS Blue Level
	8-B-3	Evaluation of Revised Third Grade, MANS Green Level
	8-B-4	Three Evaluations of Gifted Student Use
	8-C-1	Preliminary Study of CSMP "Graduates"

Key to Indexing

Evaluation Reports are labelled m-X-n,
where "m" is the year of the pilot study, with 1973-74 as Year 1.
"X" is the type of data being reported where A is for overviews and summaries, B is for student outcomes and C is for other data.
"n" is the number within a given year and type of data.

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I. Introduction

Since 1973, the Comprehensive School Mathematics Program (CSMP) has been developed, pilot tested and widely used in schools. Adopted by 134 sites across the country, it has been a massive curriculum development and implementation effort involving over $10 million in Federal funds and countless dollars invested by adopting school districts. The longest running, most intensively monitored result of the mathematics instructional reform era of the '60s and '70s, CSMP has been the mathematics program for 30,000 students in 9,000 classrooms throughout the country. More than 6,000 teachers have been trained to teach CSMP, and, to assess the program's impact. Over 1,000,000 have been spent testing more than 14,000 students at 30 sites nationwide. Of all the mathematics programs spawned in the post-Sputnik era, only CSMP can lay claim to being a sustained, comprehensive, national alternative to the other "national" curriculum, the textbook.

A. Purpose of This Report [A brief summary statement follows]

This report has several goals: to summarize CSMP's implementation, and to describe the impact of that implementation on adopting school districts. To that end, data on the adoption histories of all sites which used CSMP will be presented, the contributions of participants (Coordinators, teachers, principals and others) will be examined, and the impact of the program on those participants, in the form of data collected during the nine year evaluation history of CSMP also will be presented.

Other readers will want to consider adopting CSMP, or reviewing their decision to adopt it and may want their review to be based on the general history of the program. Thus, the highlights of CSMP's history are provided.

This report discusses many of the key features of CSMP implementaton (adoption data, implementation strategies, Coordinator data, etc.), but at an unfortunately superficial level of detail and generality.

Since CSMP is not a simple program, but represents a complex development effort which supports training of teachers, development of materials and continuing program evaluation, and since it does not resemble traditional mathematics programs, the content and the goals of the program need to be explained. Only then will the constraints and advantages of the program for adopting school districts be understood. Thus, a history of CSMP implementation must describe the content and pedagogy of the program. Subsequent sections will discuss the components of CSMP, its materials, training program, the role played by Coordinators and teachers as well as its impact on students.

Over its long history CSMP has documented its goals and procedures in reports, articles, and program materials such as Coordinators' manuals and Teacher's Guides. Rather than produce a brief superficial summary of all the key points which ought to be described and commented on, we have elected to highlight a few major issues. A more comprehensive treatment of the topic would demand more time than was allowed us. Thus the reader is urged to review the CSMP documents listed in Appendix A of this report as well as the CSMP evaluation reports produced by the the Mathematics Research and Evaluation Studies unit reponsible for evaluating CSMP. A listing of those reports is given on page iv. Appendix B includes a list of the sites where data was collected.

B. Brief Description of the Contents of the Report [Omitted from this draft copy]

II. CSMP: PROGRAM DEVELOPMENT AND DESCRIPTION

A. Philosophy and Goals. [Brief Draft Summary Statement]

Like SMSG, UICSM, the Madison Project and other mathematics reform projects of the era, CSMP was designed to teach students mathematics, and not merely arithmetic. Since CSMP appeared on the national scene after the other math projects had been piloted, it was able to avoid some of the problems that had plagued earlier math innovations. CSMP was also fortunate to have institutional support (since CEMREL, Inc., a national education laboratory provided housing and logistical support) and relatively stable long-term funding cycles during the critical early developmental years.

To support development, an in-house staff of mathematicians, writers, editors and artists produced the materials and an external panel of consultants, all nationally known mathematicians, critiqued the materials during all development stages.

One of the key aspects of CSMP is its dual emphasis on both mathematical content and pedagogy designed to support mathematical reasoning. As the program was developed, it was piloted and revised so that both the content and the pedagogy reflected experience with the world of elementary school teacher and student.

One of the basic tenets which CSMP developers have often stated, is that the teaching of mathematics in elementary schools should not stress drill on arithmetic but should introduce children to what the developers term "mathematically important ideas".

To present those "mathematically important ideas" to students, three basic principles guided the developers. These principles, which differ from those on which "traditional" mathematics programs are based, are:

- o Mathematics is a unified body of knowledge and should be organized and taught as such.

- o Mathematics as a body of knowledge requires certain ways of thinking.
- o Mathematics is best learned by a student when applications are presented which are appropriate to students' levels of understanding.

and to support these principles, distinctive content, languages, and pedagogy were developed.

[Brief Draft Summary Statements follow]

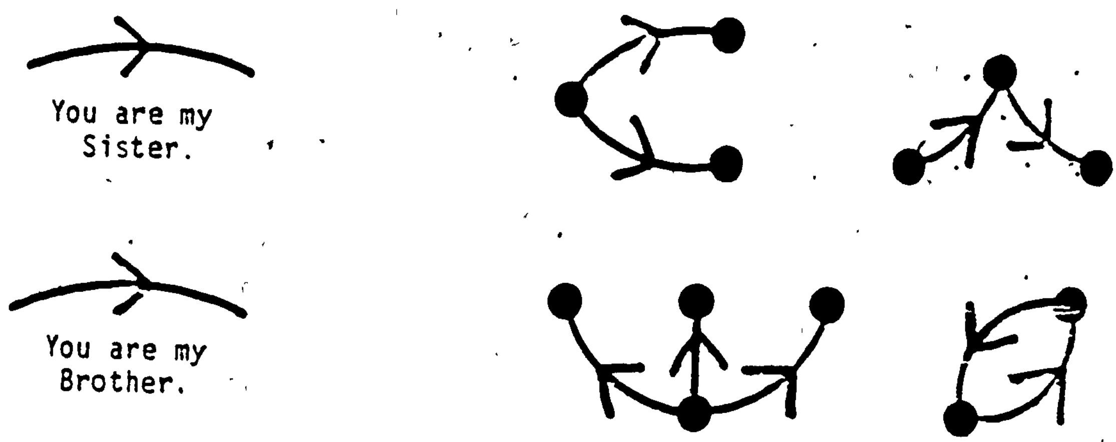
B. Distinctive Language and Content.

On a day to day basis CSMP seeks to develop students' knowledge of the standard number systems (natural numbers, integers, rational numbers, decimals, and real numbers) interwoven with combinatorics and metrics as well as affine geometry. From second through sixth grades, probability and statistics lessons also contribute to the lesson sequence.

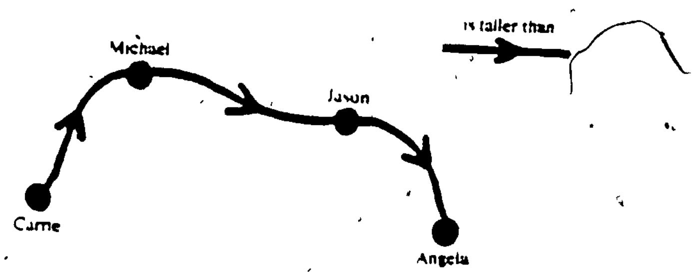
To provide that distinctive content, CSMP developed distinctive languages. Many educators have thought that students need to have mastered their own language before they can handle logical mathematical tasks. Instead of waiting until that mastery has been attained, CSMP has developed three novel languages. Simple, precise and pictorial rather than verbal, they express the abstract concepts embodied in the content.

The Language of Arrows provides a pictorial language for introducing both numerical and non-numerical relations to elementary school students. Samples of non-numerical applications of arrows are:

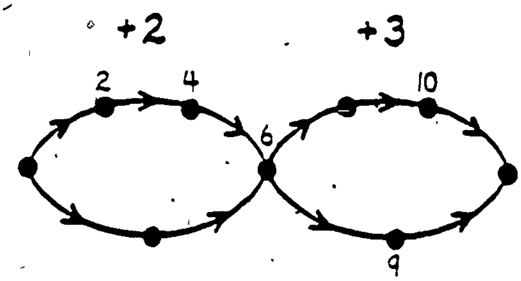
The following illustration of sibling relations employs dots to represent children.



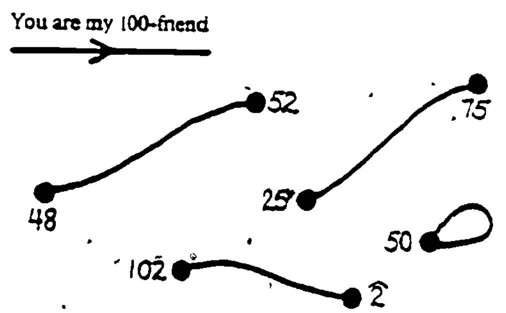
The dots in this arrow picture are for children who are pointing (represented by red arrows) at each other and saying, "I am taller than you." Carrie is taller than Michael, Michael is taller than Jason, and Jason is taller than Angela. There are three more red arrows that could be drawn in this arrow picture.



The numerical arrow roads below illustrate the relationship between the multiples of 2 and the multiples of 3. These +2 and +3 arrow roads would intersect at all the multiples of 6. In any picture only one dot is used for each number. Can you finish labeling the dots?

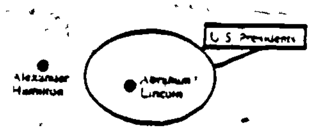


If an arrow can be drawn in either direction between two dots, then the dots can be connected by a cord. Second-grade students are asked to find pairs of numbers whose sum is 100. In the cord picture below, 50 is connected to itself because 50+50=100. An arrow that starts and ends at the same dot is called a "loop."

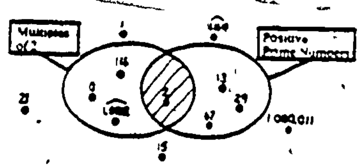


The Language of Strings provides a pictorial way of recording and communicating information about classification. The string pictures illustrate the sorting implicit in the definition of a set.

A dot inside (the region delineated by) a set's string is for an object in the set and a dot outside a set's string is for an object not in the set. For example, consider the set of U.S. Presidents. Abraham Lincoln belongs to that set, but Alexander Hamilton does not. The string picture below records this information in a precise and clear fashion.

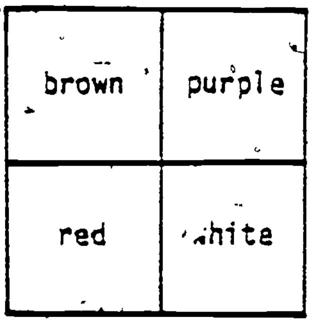


The Language of Strings is especially useful to illustrate and explore the relationships of various groups of numbers. As students correctly place numbers in the string picture shown below, they soon discover that only one positive prime number is a multiple of 2. Hatching in a region indicates that all of its elements are shown in the picture.

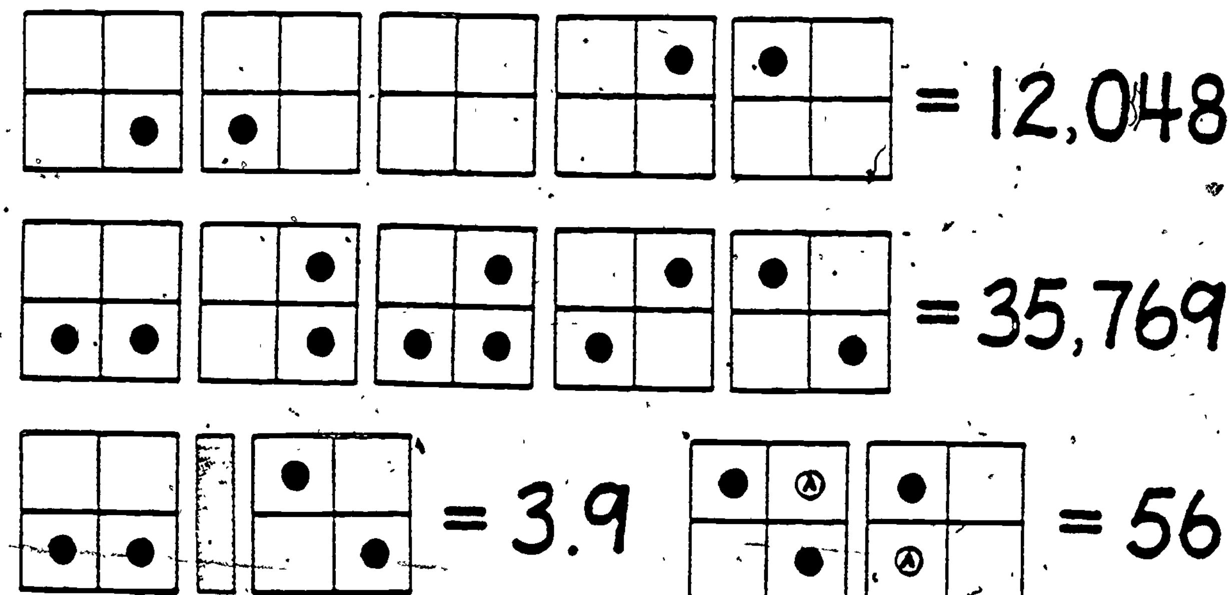


Drawing the strings and dots is not the object of the lesson, but merely the vehicle for developing students' ability to do logical thinking in a variety of ways.

The Language of the Mini-Computer models the positional structure of our numeration system and allows practice with arithmetic computation and numerical investigation. Consisting of one or more boards, each divided into four squares, and a set of markers or checkers, the minicomputer shows numbers represented by checker configurations.

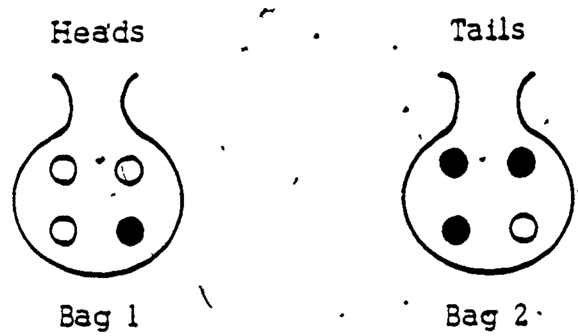


- white confers 1 (10, 100, and so on),
- red confers 2 (20, 200, and so on),
- purple confers 4 (40, 400, and so on), and
- brown confers 8 (80, 800, and so on).



Topics in Probability and Statistics find a natural place in the CSMP curriculum. The pictorial technique allows the analysis of probability and statistical situations as the following fourth grade activity illustrates.

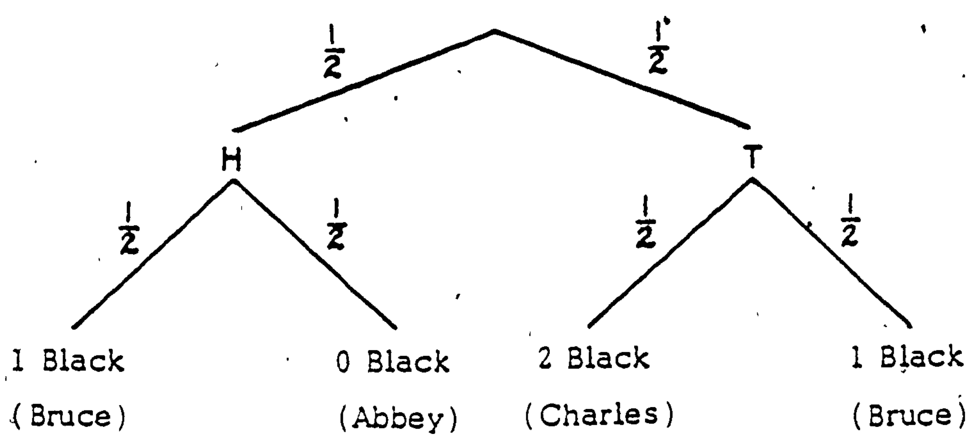
"Abby and Charles are neighborhood friends of Bruce. One day, Bruce puts three white marbles and one black marble in a bag. In a second bag, he puts three black marbles and one white marble. Bruce's game is to flip a coin. If 'heads' comes up, Abby picks two marbles from the first bag. If 'tails' comes up, she picks two marbles from the second bag."



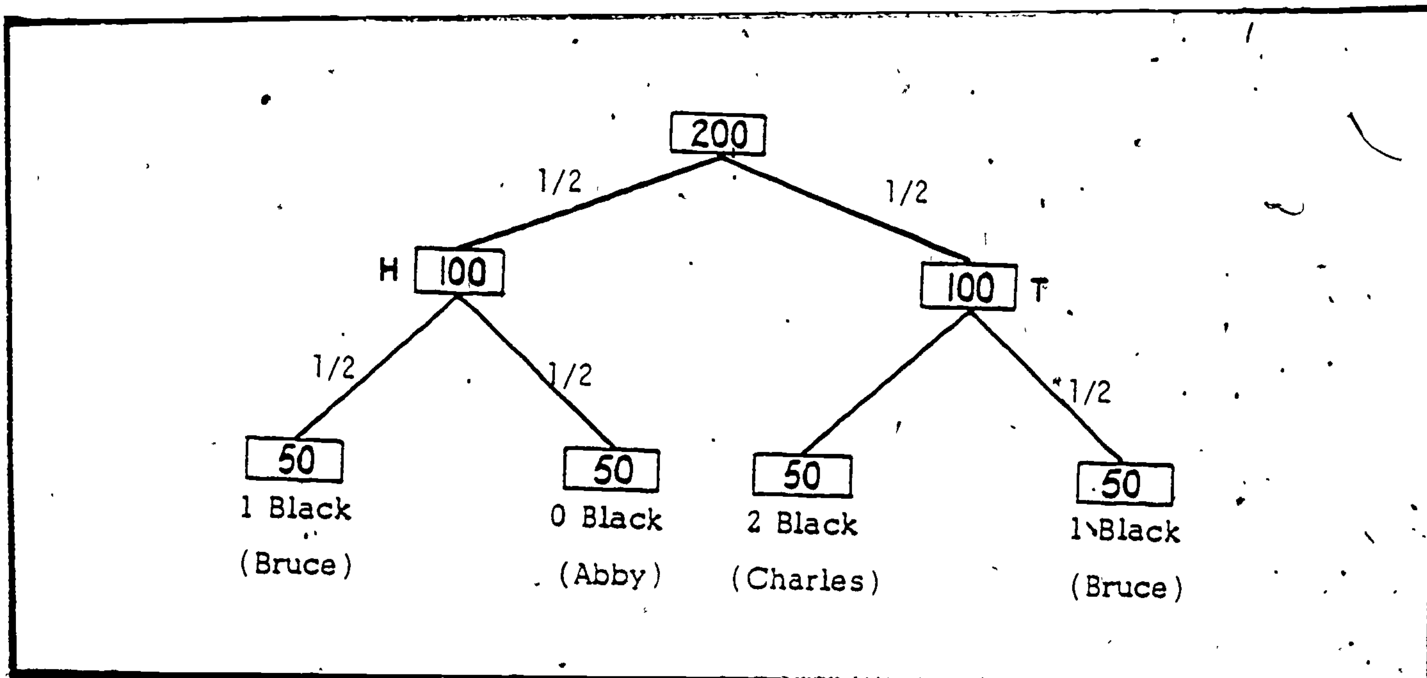
"If 0 black marbles are drawn, Abby wins.
If 1 black marble is drawn, Bruce wins.
If 2 black marbles are drawn, Charles wins."

"Abby and Charles are always suspicious of their friend's games, so they wonder whether or not it is a fair game. Do you think Bruce has invented a fair game?"

The entire game is then summarized by a tree diagram.



The tree representation suggests that Bruce is favored as only he can win in two ways. To confirm this students consider the expected outcome if the game is palyed 200 times.



The lessons in the Geometry strand provide an opportunity to explore geometric notions informally. The lessons provide a vehicle for exploring rich connection between arithmetic concepts (such as number and calculations and physical concepts like length, area, and shape.

C. Distinctive Pedagogy. [Brief Summary Statement follows]

Unlike its forerunners in mathematics reform, CSMP has recognized that pedagogy is as important as content. Thus, while content development is structured in the framework of sets, numbers, relations, and functions, CSMP also provides a pedagogical structure for developing the mathematical reasoning, imagination and intuition that developers believed necessary for dealing with mathematical abstractions. To do this, the CSMP curriculum encourages teachers to foster creativity and allow freedom of exploration with mathematical ideas. At the same time the program says that these goals should take place in conjunction with the development of intellectual thinking.

Toward those ends, CSMP developed a "pedagogy of situations" to provide students with real, simulated, or imagined tasks, which are based on mathematical content requiring thoughtful analysis. Those situations were written to be interesting to students and to provide students with rich consequences. Thus, unlike many curricula which have precise behavioral goals accompanying each lesson, CSMP aimed at evoking the possiblity of many learning goals being accomplished within any one lesson and it was expected that different students would have different experiences. In all grades, the lessons aim to increase students' knowledge of mathematical content and thought.

Another aspect of CSMP's pedagogy is the "spiral" curriculum. Instead of presenting students with a single topic to study until mastered, CSMP lessons are organized into strands: a number strand, a geometry strand, a probability strand, etc. Lessons on each strand are presented each week so that throughout the year there is increased complexity of content which calls for increased sophistication of thought.

As designed, no single lesson is an end in itself and it is not expected that every child will "get" every lesson. Instead, the sequence has been arranged deliberately so that students are given repeated exposure to content. One of the goals of the spiral is to introduce slow learners to situations in small doses. Another goal is to allow students to experience, assimilate, apply and react to more varied mathematical experiences in a shorter time than they would through "traditional" mastery programs.

The spiral approach reinforces CSMP's philosophy that mastery of isolated topics does not constitute appropriate mathematical instruction. The developers chose to let the spiral model their thoughts about the unity among mathematical topics by repeated presentations in a slow but cumulative network of concepts and applications.

Thus, teachers play a key role in leading students through each lesson. At times they encourage students to look for many possible answers, or to formulate hypotheses. Thus, the program is a sophisticated, complex, combination of content, reasoning to support the content, and pedagogy to develop the thinking. In all ways it is unlike other curricula generally available.

D. Distinctive Materials [Brief Summary Statement follows]

The Teacher's Guide is extremely important. Since CSMP is highly structured, with detailed lessons provided for each day, as well as a sequence of lessons for the entire year, the Teacher's Guide must carry the teacher from training through practice with the lessons and on to eventual mastery of the content and pedagogy. The sample below, from the Teacher's Guide for The World of Numbers, Intermediate Level, shows how specifically the lessons are intended to be taught (i.e., a script is provided and illustrations to convey the ideas are shown for the teacher to reproduce on the chalkboard.)

Sample page from the Teacher's Guide Intermediate Level.

G7 Where Shall We Meet? #1

CAPSULE LESSON SUMMARY

Draw and compare several shortest paths from Nora's house to her grandmother's house. Find places which are the same taxi-distance from a rollerskating rink and a movie theater. Do a related problem involving Nora's house and a friend's house.

MATERIALS

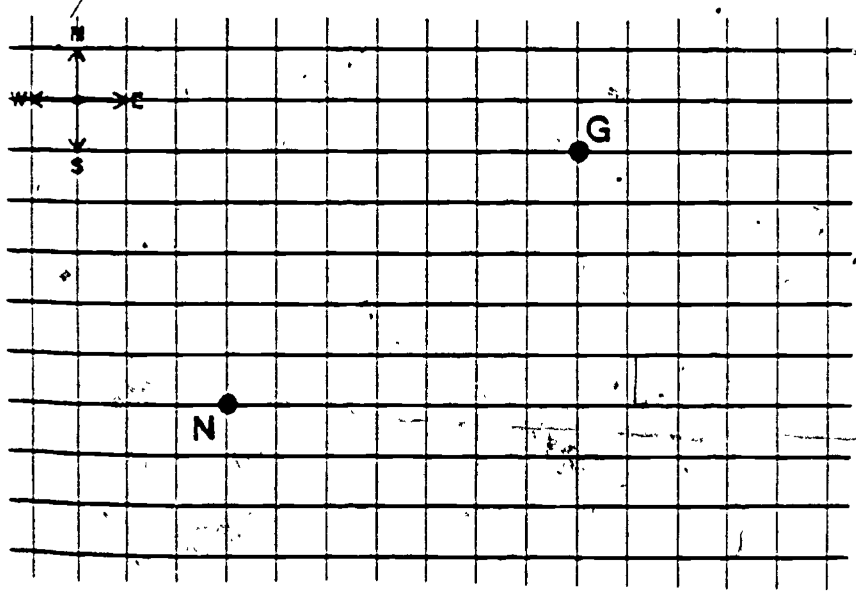
Teacher: Grid board; colored chalk
Student: Worksheets G7* and **; colored pencils

DESCRIPTION OF LESSON

Exercise 1

NOTE: This exercise is a review of Nora's neighborhood and of taxi-geometry and should move quickly.

Display a grid board. Draw and label two dots as shown below. In the upper left corner of the grid, indicate the four directions.



T: Remember this map of Nora's neighborhood. Who can tell us something about Nora?

Teacher's Guide continued.

S: Nora likes to visit her grandmother.

S: Nora sometimes takes long walks and sometimes short walks.

S: Nora doesn't cut through people's yards.

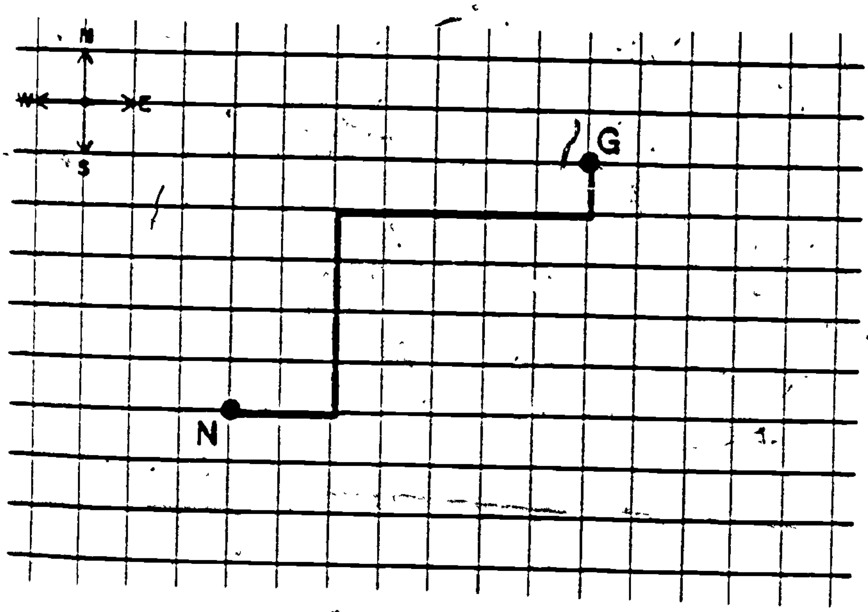
Ask someone to trace a path from N to G. Accept any path that follows the lines on the grid board.

T: Can someone show us a longer path (than the one just previously traced)?

Invite a student to trace another path from N to G.

T: When it is raining, Nora finds a shortest path to her grandmother's. Who can show us a shortest path?

Invite students to trace paths until a shortest path (in this case, one in which Nora walks only in the north and the east directions) is suggested and then draw it on the board. Help the student whose path is drawn to count how many blocks are in the path.



S: My path is 12 blocks long.

A feature unique to CSMP is the use of "story"books (in consummable books) and "story" workbooks (also in consummable books). These story settings are designed to lead students through problem solving experiences deemed important for mathematical growth.

The schedule also provides for workbook days, when students work on their own in workbooks of varying difficulty levels (one star for easy problems, two star for more difficult problems, and so on through to the four star books).

Hand calculators, Minicomputer boards for students' desk use, and string game analysis kits are examples of student materials around which various lessons are built.

E. Training. [Brief Summary Statement follows]

CSMP's uniqueness is both a strength and a liability. Its strength is its emphasis on a type of mathematics not found in commercial textbooks; its liability is teachers' unfamiliarity with its content and pedagogy. CSMP mandated training and produced a variety of guides and support services to follow up the Coordinator training provided from CEMREL-CSMP. Since the goal was to produce a teachable, manageable, learnable product, CSMP required each district to appoint a Coordinator to oversee the program locally, providing initial training and subsequent monitoring as teachers practiced and perfected the lessons. According to the Memorandum of Understanding (MOU) which school districts entered into with CEMREL-CSMP before participating in the extended pilot trials, a Coordinator must be appointed by each school distict, and should be trained by the CEMREL-CSMP staff in St. Louis at their regular scheduled summer training workshops. The Coordinator would be then responsible for conducting CSMP training workshops locally for teachers of CSMP.

The Coordinator is responsible for conducting CSMP training workshops for a designated number of hours (8 for first grades, 16 for second grade, 24 for third grades, and 32 for fourth, fifth, and sixth grade) before the academic year begins. After completing training, the Coordinator should provide support for teachers in the form of in service workshops, observation of classes, and general trouble shooting. A Coordinator's manual is provided to assist the Coordinator in training, monitoring training and following through on those administrative duties.

One short-coming of all the materials is that mathematically unsophisticated teachers are unlikely to be able to infer a given lesson's goals. While the Teacher's Guide provides a script so that teachers can teach a lesson to a class, the goals of the lessons, in terms of expected student achievement, are not always clear. Nevertheless, the lessons are always rich in possibilities, i.e., good mathmetical thinking is encouraged, even if the reason for a strategy is not always clearly defined.

In terms of the planning which went into its development, and the detail which marked its decision, CSMP was unique among curricular innovations.

F. CSMP Vs. Other Curriculum Reforms [Brief Summary Statement]

Attention to detail at the level which CSMP provides and recognition that teachers need materials and guidance in using the materials, has not been typical of the curriculum reform movement. Innovations during the '60's and '70's were marked by several key features. First, many of the innovations were designed to teach thinking skills. However, many teachers who were to implement the new curricula in their classrooms did not know how to achieve such goals. Their training had usually been directed toward teaching content and their understanding of the teaching strategies required to promote inquiry and imagination was often less sophisticated then those of the developers. Associated with this was the second problem that many innovations did not specify what content or pedagogy were to be employed as stimuli for higher level thinking.

When content was specified, and it was for many innovations, the pedagogy was often not carefully thought out and not fully specified. Thus while developers has a clear idea of what they wanted taught, that idea was often not spelled out enough to be transportable to school settings. The ambiguity resulting from trying to teach someone else's ideas daily, without the benefit of guidelines, or consultation and monitoring, destroyed some teachers' faith in their ability to be innovative.

Some developers often displayed a naivete about how fragile the prospects for change are in any system and some failed to consider the political and practical realities of the systems in which the planned change was to occur. They failed to provide adequate training to meet local needs or failed to monitor the implementation to make sure it was being implemented.

Finally, few innovations were given enough time to develop a full fledged set of lessons, monitor those lessons in real world setting and revise them to accommodate to the needs of users. Not enough time was allowed for adopters to make mistakes and experience the frustrations which would provide a data base for creating a politically and practically viable program. In the world of innovation of the '60s and '70s everything happened too fast for reflection and not fast enough for renewal.

CSMP was fortunate in that its development occurred toward the end of the innovation period we have just witnessed. As such it was able to profit from other innovators' successes and failures. Certainly the design and operation of CSMP shows an attempt to avoid mistakes made by some innovators while capitalizing the successes of others.

CSMP shared many of the goals of other reform mathematics curricula of the era, but marks a distinct departure in its strategy for achieveing those goals. Like UICSM (aimed mostly at junior high school), SMSG (a secondary program) as well as the Madison Project and other mathematics programs targeted for elementary school students, CSMP was designed to teach students conceptually oriented mathematics. Unlike many of those programs, CSMP did not present the innovation as a fait accompli which needed only a teacher to bring it to life. CSMP developers reasoned that some teachers would need help in translating the printed lesson into a class presentation and so fully specified lessons were prepared which described what to do from day to day in the classroom. This specificity sets CSMP apart from many of its predecessors.

Unlike many math projects which relied on teachers to be able to get off to a running start, CSMP planners urged each adopting school district to invest in training for the Coordinator and for all prospective teachers. Since the program relies heavily on teacher-initiated dialogue (as was shown in the sample from the Teacher's Guide) the CSMP staff believed that the program would only be taught as intended if the Coordinators knew the goals and strategies of the lessons well enough to supervise their teachers.

Thus, in many ways, CSMP attended to the political realities of school settings to a greater degree that programs preceeding it, and attempted to solve those problems by a combination of training, printed guides and support services.

G.CSMP DEVELOPMENT [Brief Summary Statement follows]

CSMP began at Carbondale, Ill. with funding from the US Office of Education and Southern Illinois University, and then at St. Louis with funding first from the USOE and then NIE. The Director of CSMP from 1965 to 1979 was Burt Kaufman, and the curriculum is in large measure a tribute to his energy and dedication. Frederique Papy brought many new ideas to CSMP during her time as Associate Director for Research and Development; her influence pervades the entire curriculum.

The CSMP curriculum is the result of a long process of development, field testing, and revision in a wide range of geographical locations. Those sites varied in size and SES of community. Students' ability levels, as measured by standardized achievement tests, ranged from the 25th percentile or below, to upper track students defined as gifted by their districts. During those trials, complete sets of Teacher's Guides and student books were written for each grade level. Materials, like the story books, the mini-computer and analysis cards for the String Game, were also provided.

Over the ten years of the project's history a four cycle model of materials development took place, essentially by grade levels :

1. CSMP staff wrote lessons and taught them informally in local classes

2. a local pilot test version of the curriculum was prepared from the revised lessons, taught by a few local teachers and observed by the CSMP staff
3. A "Final Experimental" version of the curriculum, based on a revision of the local pilot version was taught for two years in the nationwide set of schools electing to pilot the curriculum.
4. A publication edition was prepared based on final revisions resulting from the extended pilot trials.

A formal evaluation mechanism was established at CEMREL, which was structurally independent of CSMP and funded under separate contracts. This evaluation group, which came to be known as the Mathematics Research and Evaluation Studies Project (MRES) was responsible for summative evaluation based on the Extended Pilot Tests. It was also involved in working with CSMP staff on formative evaluation through third grade.

Historically, while curriculum development in conceptually-oriented mathematics has occurred via programs like CSMP, the <u>assessment</u> of problem solving abilities has not received the same attention. Hence users of these programs are held accountable for student performance on measures that do not reflect their goals, especially not in problem solving (except in the trivial, computationally oriented, one-step problems that make up most of the problem solving sections of standardized achievement tests). CSMP is a process-oriented curriculum; the mathematics is embedded in situations that require problem solving, though often in the content of the special languages of CSMP. The problems of evaluating student achievement are complicated since there are no norms for problem solving in these contexts and comparisons are difficult because of the non-standard terminology. Nevertheless, MRES has developed a methodology for carrying out such an evaluation in comparative studies that are rooted in problem solving, and the measures developed have been shown to be sensitive to instruction.

The primary purpose of MRES' evaluation of CSMP has been to provide information about the program to consumers, developers, and the funding agency. The results of the evaluation have dealt with multiple outcomes from different patterns of use, and the value of the curriculum must eventually be determined by weighing those various outcomes according to the relative worth placed on them. However, evaluation data about CSMP provide a information about the impact of the program on students.

III. CSMP IMPLEMENTATION

A. Adoption Histories, Patterns of Adoption, Expansion, or Discontinuance. [Brief summary statement follows]

Once CSMP had been locally piloted and was available for wide use, school systems were contacted and urged to adopt the materials. The key to CSMP adoption and implementation history is variety. CSMP has been adopted in 28 states nationwide. The mix of sites is varied; six large urban school systems like Detroit, 73 rural county districts like Catoosa County, GA. and small town school districts like Pekin, Ill. and 17 suburban school systems, like the Greenburgh Central School District #7, in Hartsdale, New York. Five Indian schools and 33 private and parochial schools also have adopted CSMP. It was a Title I adoption in at least 4 sites, a Gifted program in at least 12 sites, and a remedial pull-out program at more than 10 sites. (Appendix B shows the data sources for the following chapters.)

Sites varied in the length of time they used CSMP and the strategies they used to implement it. Table 1 shows the pattern of adoptions and the length of adoptions for the nine years the program has been available.

Table 1
Length of Adoption, Number of Years by Adoption Year

Number of Years Adopted	Year of Adoption	1973-74	1975-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82
1 year		3	1	6	0	1	0	0	1	23
2 years		9	1	4	0	0	0	3	21	
3 years		1	0	1	1	0	1	19		
4 years		3	0	0	2	0	4			
5 years		0	0	0	1	2				
6 years		0	1	1	4					
7 years		0	0	3						
8 years		3	3							
9 years		9								

▭ Indicates the number of sites which have adopted and implemented the program for the maximum number of years possible based on <u>their</u> first year of adoption

There were at least three general patterns of adoptions. First, many sites adopted CSMP and continued it for the full time possible (e.g., nine years for 1973-1974 adopters). Excluding the data from new sites (since 1980), 47% of the sites fit this pattern of continuing it for the maximum. Second, some sites adopted CSMP for only one or two years; 32% of the sites (again excluding data from 1980-1981 and 1981-1982) fit this pattern. Third, some sites adopted CSMP for more than one or two years but less than the maximum number possible; 21% fit this pattern.

Table 1 tells only part of the story because each year at each grade level some sites were dropping CSMP while other sites were adopting it and still others were maintaining it. Table 2 shows the number of sites dropping and adding each year. The percentage of sites continuing is also shown.

Table 2
Pattern of CSMP Usage,
By Sites, 1973 to 1981

Fall, 1973	Fall, 1974	Fall, 1975	Fall, 1976	Fall, 1977	Fall, 1978	Fall, 1979	Fall, 1980	Fall, 1981
29 - 4 + 6	31 - 9 + 15	37 - 10 + 8	35 - 5 + 3	33 - 0 + 5	38 - 2 + 22	58 - 4 + 22	76 - 7 + 23	92
(86%)	(71%)	(73%)	(86%)	(100%)	(93%)	(93%)	(91%)	

Where

# CSMP Sites	-	# Sites Dropping	+	# Sites Adopting
(Percent Continuing)				

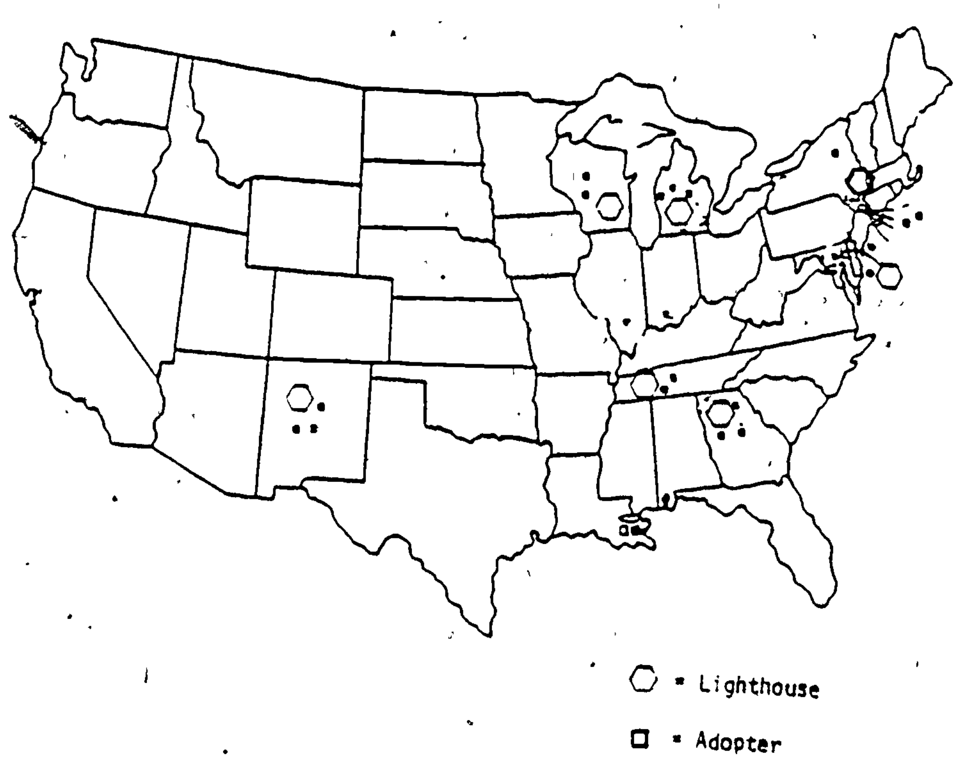
Is Shown

Lately both the length of time sites have been using CSMP and the number of adoptions per year has been gradually increasing following a low point from 1977 to 1978.

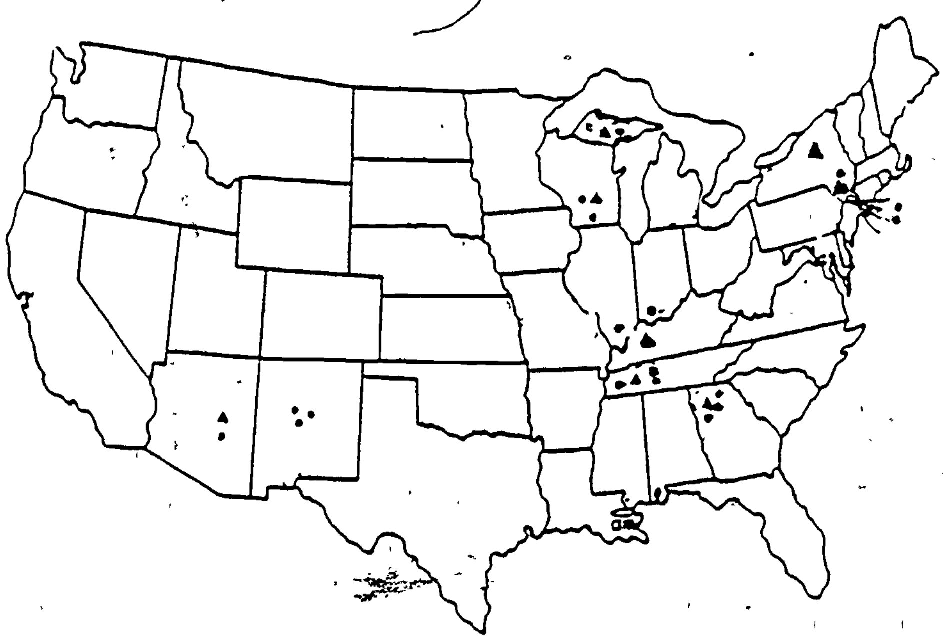
There are at least three aids to adoption. First, the philosophy and goals of the program convinced many sites to give it a trial since they wanted a program specifically aimed at emphasizing higher level mathematical processes. Second, having decided to investigate the program because of its conceptual base, many schools systems sent staff to visit sites which had already adopted CSMP. There they watched the program being taught and talked to teachers about strengths and weaknesses of the program. The presence of these "lighthouse" sites was a distinct advantage for many sites which previewed the program and decided to adopt it on the strength of what they heard and saw. The distribution of adoptions in the first few years was sufficiently far-flung that districts in many regions of the country could conveniently visit a relatively nearby site and see the program in action.

Figure 1 shows the distribution of several "lighthouse" sites as well as the sites which adopted the program based on visits to those sites.

Insert Figure 1 here



• The third aid, a critical factor in some sites being able to adopt the program, was the presence of an experienced trainer. Since the CSMP-CEMREL staff could not visit all potential sites and could not train all potential adopters, "turnkey" trainers, who were trained at CEMREL, were able to train teachers in their region. The presence of " turnkey" trainers and the sites they visited is shown in Figure 2.



The program is more wide-spread at the primary level (Kindergarten, first and second grade), than it is at the upper elementary levels. Table 3 shows the number of sites which implemented it at each grade level.

Table 3
Number of Sites,
By Grade and By Year
Percentage of Sites Per Year are Shown in Parentheses

	K	1	2	3	4	5	6	TOTAL
1973-74	29 (48%)	31 (52%)						60
1974-75	28 (37%)	29 (39%)	18 (24%)					75
1975-76	31 (30%)	29 (28%)	24 (24%)	18 (18%)				102
1976-77	24 (20%)	29 (24%)	27 (23%)	23 (19%)	16 (13%)			119
1977-78	25 (17%)	31 (21%)	28 (19%)	27 (19%)	22 (15%)	12 (8%)		145
1978-79	30 (18%)	34 (20%)	32 (19%)	29 (17%)	22 (13%)	15 (9%)	7 (4%)	169
1979-80	36 (17%)	46 (21%)	42 (20%)	36 (17%)	25 (12%)	17 (8%)	12 (6%)	214
1980-81	49 (28%)	51 (21%)	46 (19%)	40 (16%)	27 (11%)	19 (8%)	16 (6%)	248
1981-82	58 (19%)	60 (20%)	58 (19%)	48 (16%)	32 (11%)	25 (8%)	17 (6%)	298

There may be several reasons for this pattern. Since some sites adopted a gradual approach to implementation, and elected to begin using it at kindergarten the first year, first grade the next year, and so on, it would take a few years for CSMP to work its way up through all the grades at any site. But evidence from sites where there is ample time for it to have spread in that way shows that CSMP is often not used beyond third or fourth grade level.

Overall the pattern of adoptions is not as clearcut and straightforward as the three factors would make it appear. In addition to those adoption factors, opportunism also played a role in CSMP adoptions. Money, either Title IV-B or other sources, was available and some districts used it to their advantage to adopt CSMP. In some cases, when the funds dried up, districts found other ways to support the program. However, many dropped the program when the funding was curtailed.

CEMREL's own mandate from the government also affected adoptions. Over the years, the government had first counseled CEMREL to look for a national audience for the program, then to focus on attracting large urban school systems to the program, then to turn attention to potential adopters within the ten state region defined for CEMREL by the National Institute of Education, CEMREL's funding agency. These shifts in focus affected the dissemination staff's emphasis on adoption. However, CSMP was able to develop a very sophisticated set of materials and brochures (see Appendix A) to support their dissemination efforts.

Having decided to adopt CSMP, sites differed in the implementation strategy they chose. Some sites decided to adopt CSMP system-wide, in all grades in all schools the first year. Others adopted a more gradual approach and adopted it at one grade level (usually kindergarten or first grade with the intention of expanding a grade or two each year). Other sites elected an experimental approach and tried it in one school as a test case, reserving the option to expand or drop it when the "experiment" had been assessed. Often what many sites did was not what they had originally intended to do but was dictated by local constraints.

B. How CSMP Got Started at the Sites [Omitted from this report]

C. The Role of the Coordinator [A Brief Summary Statement follows]

One of the key factors in the success of CSMP as a national program has been its insistence that adopting school districts appoint a "Coordinator" (usually a local administrator or teacher) who would assume day to day responsibility for the project by ordering supplies (or overseeing their ordering), conducting in service and monitoring teachers as they taught CSMP lessons. Districts had different strategies in selecting Coordinators, and the choice affected the program at some sites. By now the adoption/innovation literature is full of case studies of adoptions which failed because sponsorship of a program was not well placed. Our experience with CSMP supports the literature. In the few cases where a willing volunteer teacher espoused the program, pushed for its adoption, and was given Coordinator duties but was not considered an administrator and did not function as an administrator, CSMP limped along, and was eventally dropped. The same was usually true when the principal of a school was the sponsor. It was difficult for the principal to get out of his own school into other schools, much less to effect a system-wide advocacy for the program. A well- placed sponsor with district wide responsibilities was a distinct advantage and, in many cases, protected the program when district leadership or goals changed, when standardized testing "accountability" pressures mounted or when new funding sources had to be found.

Reviewing the patterns of Coordinator influence, we found four different types of Coordinators: outsiders, teachers, administrator custodians and administrator sponsors. Outsiders were typically math professors at local universities who volunteered to introduce CSMP to the district and support its implementation by conducting in service and monitoring classrooms. They were generally able to galvanize teachers to adopt and implement the program, but they were not in a position within the district to act as decision makers or protectors for the program. Thus, when a Superintendent decided for one reason or another that CSMP would be discontinued, the outside Coordinator, like the teachers, was usually among the last to know, and was not in a position to affect the decision. Teachers who acted as Coordinators were in a similar position. In fact, their influence may have been even more limited. Some were unable to galvanize the support of other teachers in their building: On the face of it, while they might seem to be a natural source of diffusion, teachers were not likely to be able to promote the program effectively. Needless to say, teachers were as impotent as outsiders when it came to advocating the program or protecting it in a district's budget.

Central office staff Coordinators tended to be more beneficial for CSMP's longevity. They were around when funding and staffing decisions were made; they had the visibility and the mobility to advertise the project within the district and the authority to monitor and critique its implementation.

There were two kinds of administrative Coordinators. "Custodians" treated the program like any other project and merely carried out their duties as specified by the Memorandum of Understanding. "Sponsors", on the other hand, were firm advocates of the program. They were usually the ones who brought the program into the district, went to bat for its adoption, and acted as trouble shooters. When funds were low, they tried to find other ways to finance it; when teachers seemed to need more in service, they arranged for it and when there were questions about the program's impact on students, they went out and contracted for evaluations so the program could be considered on its merits.

In our view when CSMP was "in trouble" in a district, a sponsoring Coordinator would often regard the difficulties as minimal while a custodial Coordinator viewed the difficulties as yet one more obstacle to continuation.

Reviewing the data from our 1981 round of site visits, we found that of the seventeen Coordinators interviewed, seven were in Central Office staff positions, six had mathematics supervisory roles, three were school principals and two were classroom teachers. Not one had CSMP coordinating as the sole role. Thus, it is not surprising that three quarters of them reported that they attended to CSMP responsibilities "infrequently".

For some Coordinators, their CSMP functions constituted a second, almost full-time job. Acting on the specifics of the Memorandum of Understanding, they ordered materials for the district, attended CEMREL's in service, conducted district in service, monitored classes, critiqued and demonstrated lessons, met with parents and arranged for CSMP's impact on students to be evaluated, all this in addition to their <u>other</u> school system duties like coordinating the district's gifted program or administering the curriculum division. Other Coordinators treated CSMP as a part time responsibility and delegated most work. They had teachers order the materials, let the math coordinator supervise the classroom teaching, etc. In many cases this was not from lack of interest in the program, but from lack of time to fill multiple roles.

Classroom visits were the most common activity (but only 65% of the Coordinators reported time for classroom visits). Evaluation activities were undertaken by half the Coordinators but only four of the seventeen conducted training, the rest turned that responsiblity over to a turnkey trainer or others in their school district.

While many of the Coordinators interviewed in '81 had direct personal involvement with CSMP and were responsible for initiating its adoption and participating in training, others inherited the job from the previous Coordinator or from an interested advocate within the system but had no ownership involvement themselves. Three-quarters of all Coordinators viewed themselves as ultimately responsible for decisions specific to CSMP's day to day operations but were not the ones who make the decision to renew funding for CSMP.

The majority of the Coordinators visited in '81 reported funding the program out of their District's operating budget. A school's text book fund or the district's operating funds were generally used for books and supplies. Thus, and unless prices for materials continued to rise dramatically, most of those Coordinators thought they would be able to continue the program in spite of the fiscal problems facing their districts. That may be realistic, but data from previous years show that other sites which had adopted the program and intended to continue it were not able to because of program costs.

Given local evaluation concerns, test results were often a critical factor. Several Coordinators expressed faith the CSMP would meet their own goals, which were not related to performance on standardized tests; they relied little or not at all on those scores. Others thought the program was in difficulties when there was little or no difference between CSMP and Non-CSMP students on these standardized tests. Both of these may have been unrealistic views.

Some Coordinators were math educators first and administrators second; for others the reverse was true. Certainly being mathematically trained helped some to understand the goals of the program (which were not always spelled out). They were better prepared than their less mathematically sophisticated colleagues to present the mathematical content and processes in the in service. But others who did not have a strong math background, but who did understand the conceptual development that CSMP aimed for, were effective sponsors. Either a strong math background, or an understanding the aims and pedagogy to support those aims, was necessary for successful Coordinator functioning. Otherwise, the program was a flash in the pan at some sites.

A major factor in CSMP's success at the sites was the Coordinators' role in their school system, their belief in CSMP's goals, and their degree of active sponsorship. Active sponsorship flowed from a firm belief in CSMP's goals, and was most effective when the Coordinator was well-placed in the district's administrative hierarchy.

D. Training Staff and Conducting Inservice [Omitted from this report]

E. Costs of the Program. [Omitted from this report]

F. Testing and Achievement [Omitted from this report]

G. Local Events and Changing Circumstances. [Omitted from this report]

H. Teacher Background and Experience [Omitted from this report]

I. The School As A Unit and The Principal [Omitted from this report]

J. CEMREL's Relation to the Sites [Omitted from this report]

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IV. The Classroom Setting

A. Teacher Background and Experience. [Brief Summary Statement follows]

Teacher Questionnaires have been administered each year as part of the on-going evaluation of CSMP and the same items have appeared for four, five or six years so that data from each successive grade level could be collected and analyzed. Over the last nine years, CSMP teachers and recently, Non-CSMP teachers, completed the yearly questionnaire. One goal of the questionnaires was to collect data on teachers' backgrounds and teaching. The Non-CSMP teachers were in classrooms which served as comparisons in the comparative evaluation studies of student achievement. Regardless of where they taught or what grade level they taught, CSMP teachers had similar teaching experince to their non-CSMP counterparts and had taught for about the same length of time. Like their Non-CSMP counterparts, they supplemented the math curriculum for about 20% to 25% of their math time but their supplementing was usually with computation whereas the Non-CSMP teachers usually taught "enrichment" activities (computer activities, problem solving, statistics, etc.) not available in their textbooks. It is worth noting that many of the activities which non-CSMP teachers taught as supplementary to the text were components of the CSMP program.

In CSMP classrooms, teachers spend an average of 51 to 59 minutes on math instruction and this amount of time is generally 5 to 10 minutes per day more than Non-CSMP teachers reported. Some teachers spend <u>more</u> than 60 minutes, and some spend quite a bit less (30 minutes in some classrooms), but for the last few years, the time spent on math instruction is less than it was in the first few years when almost half the teachers reported spending an hour or more on math.

CSMP teachers are likely to spend more time on teacher led work and the CSMP teachers' emphasis on teacher led work is a natural result of following the Teacher's Guide, with its detailed lessons plans. The lessons are designed to be led by a teacher. If the Teacher's Guide is being followed, the high proportion of teacher time is inevitable. While CSMP teachers teach more teacher-led lessons, they also report liking this aspect of the program.

CSMP teachers have consistently given high ratings to the quality of the program and indicated it is superior to programs they have taught in the past, In this respect, their ratings have been higher than Non-CSMP teachers on:

- Students' involvement and interest
- Students' logical reasoning
- Students' achievement in mathematical concepts
- Appropriateness for high ability students

and they have given slightly lower ratings to:

- Students' achievement in computational skills
- Appropriateness for low ability students.

In response to open-ended questions, the overwhelming majority of CSMP teachers gave the program consistently high evaluations. Many reported that the program had a positive impact on their students. Others commented that the program was the most stimulating professional experience of their lives. When the program was new, or when teachers were new to it, such results might be attributed to a "Hawthorne effect" but even teachers who taught the program for several years continued to give it positive evaluations.

In a sense, the structure of the program, its highly detailed lessons, its plan of lesson sequences, which many critics find stultifying, may have been an advantage. Many innovative curricula of that period presented a point of view about what was supposed to happen to students. They were supposed to be more creative or more logical in their thinking. They were to discover more, or question more. But few programs actually spelled out <u>what</u> teachers were to do or say to bring about those changes. CSMP's structure, while it may have been different from anything teachers had ever taught before, did give them something tangible to work with day to day.

Features like the distinctive pedagogical style, the use of the spiral approach, allowing slower learners to proceed at their own pace, and teacher directed lessons which are briskly paced have usually received favorable ratings from CSMP teachers.

As each new grade level was introduced and teachers were trained to teach it, they usually reported that their preparation time was "more at first but the same as other programs after a year's experience".

Although there was some slight variation from year to year in teachers' responses, compared to Non-CSMP teachers they were more likely to report that in their math class "achievement was oriented towards more general progress" (versus "to basic skills"), "lesson plans are followed in great detail" (versus "serve as a general guide"). Generally, teachers said that "content is challenging for most students", and that "math class was one of my favorite time". Teachers were also more likely to say that they "oriented their classes toward creative activities (versus "solving specific problems") and that "Math is easier (not harder) to teach".

Every year teachers have responded positively when asked to provide an overall evaluation of CSMP. The program's effect on students has been a key point mentioned by CSMP teachers. The teachers think CSMP helps students think logically, enables them to analyze situations, and gives them a deeper level of mathematical, not just computational, understanding.

This positive assessment is tempered somewhat by some teachers' concerns about low ability students' performance in the program. A significant number of teachers, though still a minority, rate CSMP much lower on its "appropriateness for low ability students" than they rate other aspects of the program and lower than Non-CSMP teachers' ratings. This may be because they don't see the same type of day to day reaction to the program from those students as they see at the higher ability levels. On the other hand analyses of MANS test data by ability levels show low ability students to be doing better on the tests than their non-CSMP counterparts and to be showing year to year growth at about the same rate as the CSMP students of higher abilities.

A key to CSMP's success is the support and enthusiasm shown by the vast majority of CSMP teachers. In fact, the program exists at many sites today because teachers have continued to teach the lessons in spite of diminished support and sponsorship in their districts. In a rare, but not unsurprising case or two, teachers were so commited to CSMP that when Coordinators resigned or changed assignments, teachers talked their principals into assuming the Coordinator's role.

Teachers have taken a sponsorship role in training other, new-to-the-program teachers at some sites, have formed "teacher hot-lines" to support one another, and have worked to adapt lessons and materials to district conditions. In some cases, their advocacy has surpassed that of many Coordinators. Over time, teachers have volunteered to teach the program on a trial basis, to attend the training, and then work to learn the program after training ended, to spend additional time to master the content and pedagogy and to act as advocates within their own system and toward other school districts. In fact, many teachers have become such staunch advocates of the program that they continue to teach it long after district level sponsorship has waned.

On the other hand, many teachers disliked teaching CSMP. The most common reasons given were the amount of effort required, a perceived lack of basic computation activities, or the belief that many students, especially lower ability students, were not benefitting from the program. For some teachers, who did not actively dislike the program, it nonetheless appeared sufficiently difficult to teach that, in spite of taking an interest in it, they never really tried to teach it. Needless to say the role of the Coordinator was especially important in those latter situations.

Participating in CSMP has served as a means of teacher renewal and CSMP training constitutes one of the few remaining concerted in service efforts in the country today. So even though many school districts only adopted and used CSMP formally for a few years, its adoption constituted an opportunity for in service in mathematics which might not otherwise have been available or affordable. In their evaluations of CSMP, many teachers have commented that CSMP training was a stimulant in their careers and was one of the most positive aspects of their teaching. What all teachers comment on is the positive attitudes CSMP students have toward the program and the substantive, non-trival learning which the program fosters.

B. Logistics. [Brief Summary Statement follows]

To teach CSMP, teachers have to meet a double set of goals: to understand the mathematical content and its applications, and to develop a repertoire of techniques and processes for teaching the content.

CSMP's development was based on the belief that no single method of classroom management suffices to meet the needs of every student, and so opportunities are provided for the whole class to work together as well as for independent study.

Based on classroom observations at over 40 sites we can say that most teachers have met both goals. Teachers have adapted CSMP to local conditions, or accomodated it to their own preferred style of teaching. Many of the adaptations were aimed at meeting the needs of the low ability student.

Other adaptations include omitting lessons, or repeating lessons. Due to time pressures, many teachers report omitting all or part or strands like Geometry and Probability. Often this is due to the extra time teachers think must be spent on additional computational practice. Many teachers use CSMP as a supplement to the traditional math text. A few teach a complete lesson from that text and then teach a complete CSMP lesson. Others do a quick set of computation drill exercises and then teach a complete CSMP lesson. Now and then, a few teachers will teach a formal textbook type lesson in a topic, say decimals, before teaching a CSMP decimal lesson.

Some of the adaptations were "cosmetic". For example, a few teachers took the Teachers' Guide apart and bound it in a spiral binder so that lessons followed one another in the sequence they would be taught, not bound by strands.

Other adaptations were designed to make CSMP teaching resemble the way other subjects in the district were taught. So a group of teachers at one site made transparencies of every lesson and used overhead projectors to display the diagrams rather than drawing them on the chalkboard.

Some teachers, to reduce preparation and paperwork, have introduced "team" approaches to the lessons. At one site, one teacher takes responsibility for an entire strand, say the World of Numbers, and another teacher takes responsibility for a different strand. Another version of teaming, used at another site, calls for one teacher to teach a lesson to a collection of high ability students from several classrooms and another teacher to present the same lesson the following day to a collection of low ability students.

Some adaptations are ingenious improvements. By using two mini-computers, one to show the mini-computer checker configuration at the start of a lesson, and the other to work out the new configuration, teachers believe they can help students better understand the lesson. Other teachers encourage students to act out lessons involving concepts like "greater than" and "less than", and some teachers use smaller numbers than those given in the text when introducing what they think will be a difficult concept. At some Indian school sites, aides translate the lessons for students.

While a few teachers report not using the spiral, instead changing the lesson sequence so that all the lessons in Geometry are taught consecutively and all the lessons in the World of Numbers are taught in another block, most teachers rate the spiral approach positively. However, a minority do say that there is too much distance between topics in the spiral.

According to teachers who have taught CSMP for several years, they grow more receptive to the spiral with experience. Those experienced teachers also report spending less time managing materials, and less preparation time.

Another persistent issue to teachers is the lack of means to evaluate students' progress on a day-to-day or week-to-week basis. Since the program has no built-in means of testing students and since the content is sufficiently novel to discourage teachers from creating their own tests, many teachers worry about how much and how well students are learning. This is a particularly serious concern for teachers who are faced with pressures of standardized testing each Spring.

C. Patterns of Training and Teachers' Reaction to Training. [Brief Summary Statement follows]

To provide teachers with an understanding of CSMP content and pedagogy, the CEMREL-CSMP staff counseled adopting school districts to participate in the training programs held each summer at CEMREL. The workshops were designed to give teachers a conceptual overview of the program and practical demonstrations of how to teach the lessons. In designing the workshops CSMP has mandated the minimum amount of training which should be offered at each grade level. In our experience, the majority of teachers have not received the minimum. Teachers consistently rate the training positively, so it is the economics of training and not problems with the quality of training which affects the minimum.

When training has been offered, it has most often been completed, as recommended by CSMP, a week or so before formal CSMP teaching in the classroom is begun. Some sites elect to conduct a day or so introductory workshop and then continue informal training throughout the year. Less than a quarter of the CSMP teachers receive follow-up training after beginning CSMP teaching.

D. Responses to Program Goals. [Omitted from this report]

E. Facility in Teaching the Program. [Omitted from this report]

F. Student Achievement. [Omitted from this report]

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V. STUDENTS

[A Draft Version of Student Achievement has been prepared and published as Evaluation Report 9-A-1. It summarizes the data from nine years of evaluation activities conducted by MRES. This section merely highlights some of the key points of the evaluations]

Every year since the program's inception, students have been tested so that CSMP's impact on students could be assessed. Beginning in 1973, and each year thereafter, CSMP classes participating in the Extended Pilot Trial, and Non-CSMP classes in comparable districts, were tested by MRES, the unit established to evaluate CSMP. (Appendix B shows the sites where testing occurred, as well as the number of classes participating at each grade level).

To evaluate CSMP, MRES developed the MANS Tests (Mathematics Applied to Novel Situations), a collection of short tests that assess how well students in grades 2 to 6 can use mathematical thinking and skills to solve problems that are new or unfamiliar to them. As designed, the tests do not contain any of the special vocabulary or terminology of CSMP and are generally built around mathematical situations that are unfamiliar to both CSMP and Non-CSMP students. This use of novel situations means that the tests are generally rather difficult and have a problem solving emphasis.

There is a rough correspondence between the MANS tests and the ten goals for mathematics education endorsed by the National Council of Teachers of Mathematics. The MANS tests measure students' knowledge and understanding of Computation, Estimation, Mental Arithmetic, Relations and Number Patterns, Word Problems, and Elucidation (the ability to produce multiple answers). At the upper elementary levels, Algebra, Logic, Geometry, Probability, and Organizing and Interpreting Data scales are also included on the MANS tests. (A complete listing of the scales and grade levels available is shown in Appendix B).

The samples on the following page illustrate the content of some of the MANS scales.

Mental Arithmetic

Solution of numerical problems that emphasize an understanding of numbers and operations, but do not require great mental computational facility.

Examples from a sixth grade test. No "scratch work" is allowed.

7,001 − 6,999 = ____

____ − 250 = 150

98,001 − ____ = 98,000 − 3,000

12 x 500 = ____

101 x 43 = ____

7 x 43 = 301

14 x 43 = ____

Number Representations

Recognition, or prodution of different ways of representing numbers, including place value, number lines, measurement.

Example from a second grade test. For each of the first group of items (A through F), the tester says aloud a number for students to write in the blank.

E. ____________

F. ____________

What number is 1 more than 356? ____________

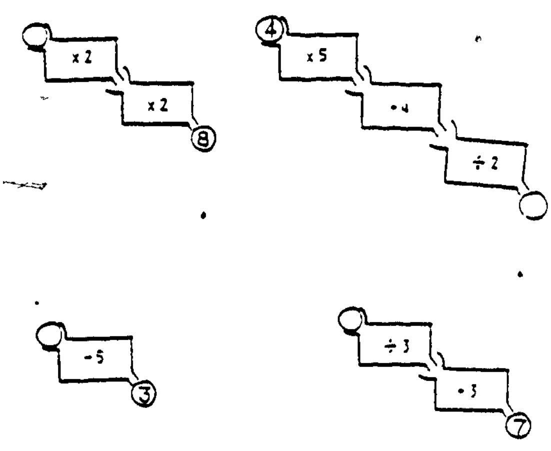
What number is 10 more than 402? ____________

What number is 100 more than 601? ____________

Relationships and Number Patterns

Recognition or application of given patterns, orders, or relationships in sets of numbers.

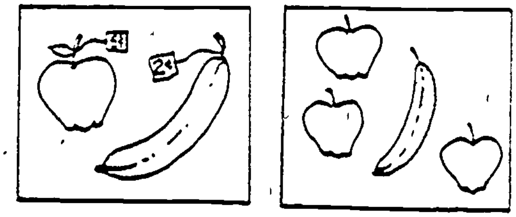
Examples from a fourth grade test. Three sample items, explaining how the "machines" work, are done previously.



Word Problems

Solution of word problems requiring low levels of reading comprehension and computation and classified according to type of problem.

Examples from a second grade test. Tester reads the items aloud, frame-by-frame.

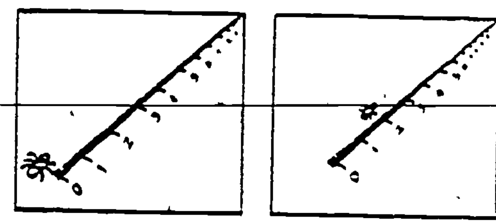


Apples cost 5¢ each and bananas cost 2¢ each.

Sally buys 3 apples and 1 banana.

How much does it cost altogether?

______



A fantastic ant is starting a trip.

After one day the ant has gone 2 miles.

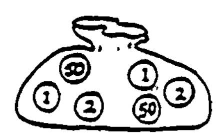
At that same speed, how far will he be after 5 days?

______

Elucidation of Mutiple Answers

Production of many correct answers to a given problem.

Examples from a sixth grade test.



Rules: Take out three balls.

Add to get a total score. ~~50~~, ~~100~~

Give all the possible scores. 52, ______

______

Rules: The numbers must be between 500 and 940. ~~499~~

Two of the digits must be 9. ~~900~~

Give all the correct answers. 909, ______

______

Special Topics

In the upper elementary grades there are also tests in one or more of the special topic areas of algebra, geometry, probability and organizing/interpreting data.

The development of the MANS tests occurred sequentially, one grade at a time. At each grade level, the Mathematics Research and Evaluation Studies (MRES) staff first developed prototype tests. Sometimes the ideas for the tests were adapted from ideas in previous research in mathematics education; most times the ideas were original. An Advisory panel (whose members are listed in Appendix C) independently reviewed all of the test prototypes. Occasionally, teachers, math supervisors and researchers also reviewed the tests. If the tests survived these reviews, they were pilot tested in a few local classes. On the basis of results from these pilot classes, tests were revised or, in some cases, eliminated.

The original version of the MANS Tests resulted from this continuing process of development, review, testing, and revision. The original version of the MANS Test was used in the first CSMP evaluation study involving 15 to 20 classes. After further refinement of the tests, they were used in the final evaluation of CSMP at that grade level. This evaluation study involved from 40 to 60 classes.

At each stage in this process of development, review, testing, and revision, the work was guided by the Advisory Panel. Some of the important considerations in the review and revisions of these tests, were the following:

- Intrinsic Merit: importance of the mathematical skill required; curricular fairness; student interest in the novel problem context.

- Administration: clarity and brevity of directions; student understanding of the task; low reading level; attractive format; unspeeded
- Technical: item analysis including range of difficulty levels, error analysis, discrimination coefficients; test analysis including ceiling and floor effects, ability level differences, reliability (KR 20 studies of internal consistency), analysis of class means and evidence of construct validity.

As used in CSMP evaluation, the tests were administered in two sessions per class by testers who were specially trained by the CSMP Coordinator at the sites where testing was being conducted, or by MRES staff, in cases where a Coordinator was unavailable. Training was conducted according to the training manual for administering MANS. The manual was specifically prepared by MRES to standardize training.

Testers were trained to follow a standardized script which includes sample problems. The students work through the sample with the tester, and then do the remaining items in that test, and then the process is repeated for the next test.

Here is a sample of the directions read to students by the tester (from the third grade MANS test) and samples of the student pages.

Sample test from third grade.

Tester Directions

Look at the number line at the top of the page. (Demonstrate.)

The numbers on that line are 2, 6, 10, then a box, then 18, 22, 25, and 30. You have to figure out what number would go in the box.

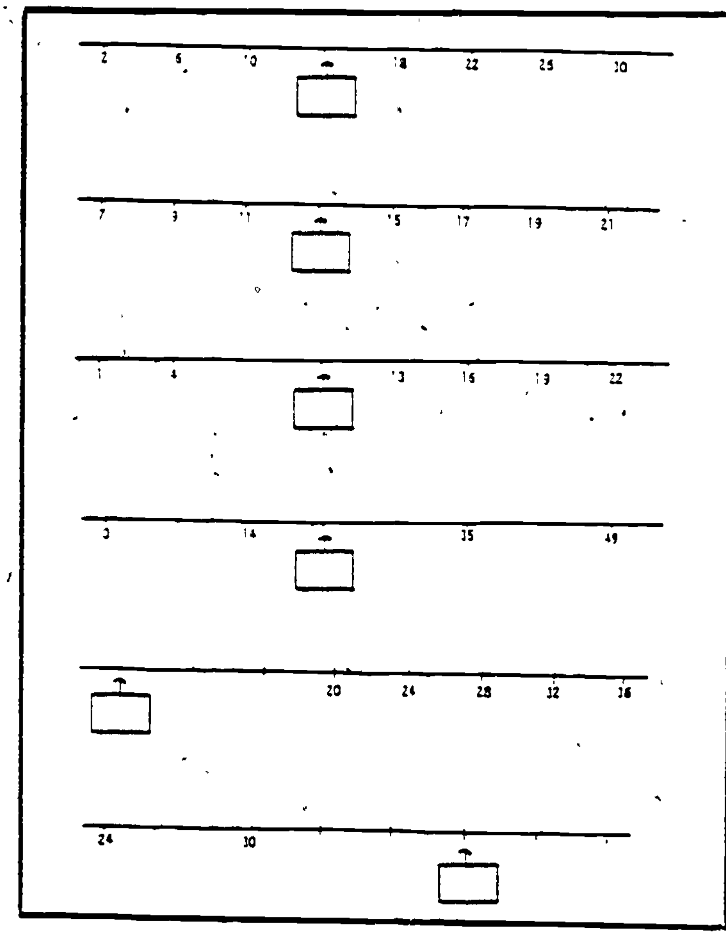
Let's find out. (Pause.) The marks are going up by 4 each time, and 4 more than 10 is 14, so you write 14 in the box and then put your pencils down. (Pause.)

In the problem we just did, the number line went up by 4 each time. But the rest of the problems may be different and you'll have to figure out for yourself how much they are going up by. Some of these are hard, and if you get stuck just go on to the next one.

Some of the marks don't have a number under them. You can write in the number if it will help you, but you don't have to.

Alright, go ahead and do the rest of the problems.

Student Page



Exact time limits are used only for certain tests, mainly those dealing with estimation skills. Most of the items are open-ended, rather than multiple choice. In order to reduce testing time, frequent use is made of item sampling, in which half the students in a class do one set of items, while the other half do another set (in which case the average score for a class is the sum of the average of these two halves of the test).

Once the tests have been administered and scored, the results are reported to school districts participating in the testing. The reporting of class mean scores for the various MANS categories is done in a normative way. But instead of showing the standard or rank of a given fourth grade class compared to all other fourth grade classes (through standard scores, grade equivalents or percentile ranks), tables and graphs are used to show the performance of that class compared to other fourth grade classes of similar ability.

The graph below shows class means (actual data) for the sixth grade classes participating in the Spring, 1982 phase of MANS testing. Each dot on the graph represents one class. The ability level of the class is measured by vocabulary score; classes farther to the right are higher in ability and, consequently, tend to have higher MANS scores (the vertical axis).

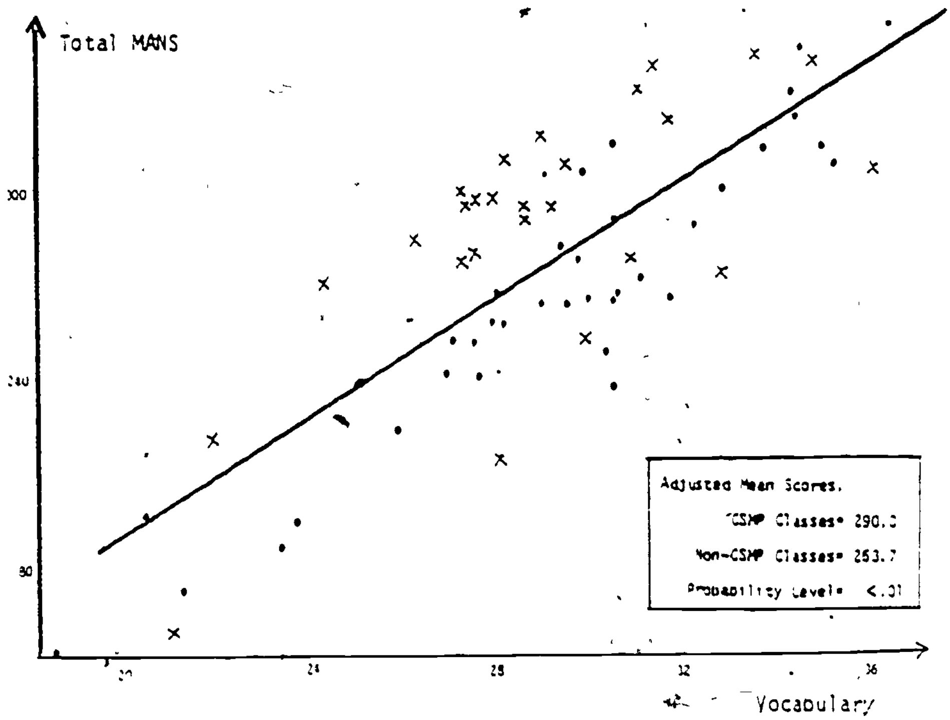


Figure 1, Sixth Grade Class Means
(x=CSMP class, •=Non-CSMP class)

Figure 3 illustrates a typical result; every year the tests have been administered, CSMP students have had better scores than Non-CSMP students. This is in spite of the fact that the scales bore little relation to either curriculum. The data are even more convincing when we consider that the CSMP students tested were similar to Non-CSMP students on the major variables like race, sex, economic background, teacher experience, and teacher competence.

Table 4 below summarizes the results across grade levels according to mathematics category being tested.

Table 4

CSMP and Non-CSMP Results

Summary of E.P.T. Test Results
All Grades Combined
Given by Test Category

Test Category	Number of Tests Administered	Number of Times Significant		Average Percent Difference	In Favor of
		CSMP	Non-CSMP		
Mathematical Processes:					
Computation	8	2	1	3.8	CSMP
Estimation	13	9	0	8.5	CSMP
Mental Arithmetic	21	19	0	19.1	CSMP
Number Representation	12	5	0	8.6	CSMP
Relationships and Number Patterns	22	16	0	20.8	CSMP
Elucidation	6	3	0	16.7	CSMP
Word Problems	13	8	0	15.1	CSMP
Special Topics:					
Algebra	4	3	0	11.0	CSMP
Geometry	2	0	1	3.0	Non-CSMP
Logic	2	0	0	0.0	--
Organizing and Interpreting Data	3	0	0	0.3	Non-CSMP
Probability	5	4	0	11.2	CSMP
Total Across All Categories	111	69	2	13.4	CSMP

There have also been some interesting secondary results from MRES' evaluations. For example, each year results have been analyzed by students' ability levels since in any curriculum evaluation it is important to know how students at all ability levels achieve. Using standardized test scores as cutoff points for ability quartiles, MRES has analyzed students' scores on each of the MANS categories. For every grade level the results were analyzed at the student level. The data show that there were differences in favor of CSMP consistently at every level of ability.

To examine the relation between students' sex and their mathematics ability, MRES analyzed MANS test data from 3,870 students at 14 school systems across the country. When the MANS test data were analyzed by sex of student it was discovered that for Non-CSMP students the total test results favored boys and this advantage occurred for each of the sub-tests except Computation where girls did better than boys. However for CSMP students the differences between the sexes were only about half as great as the Non-CSMP difference though the same pattern of boys' superiority on all categories but Computation occurred.

When the data were analyzed by type of test item it was shown that in the earlier grades, CSMP had an advantage over Non-CSMP in whole number addition and multiplication, and in fractions but CSMP had a disadvantage in subtraction. In the upper grade levels, the CSMP students had an advantage in decimals and a disadvantge in long division. These results reflect the relative emphasis placed on those aspects of arithmetic at those grade levels.

MRES has conducted 30 Joint Research Studies with school districts as part of its CSMP evaluation activities and those studies have shown the CSMP students strengths are consistent from one school district to another. In addition to those formal studies, many other kinds of data were collected in student interviews designed to assess the impact of the CSMP curriculum by presenting novel problems to students and observing the strategies students used to solve those problems.

Although CSMP was developed for use in regular classrooms, over the last few years, more than 12 systems have begun to use CSMP for students of above average ability. These "gifted" students have also been tested and the results show that there is a fairly consistent advantage in favor of CSMP at most grade levels.Similarly, "graduates" of CSMP, students who had received CSMP instruction for several years, and who had moved on to junior high school, were studied. The data are far from definitive, but ex-CSMP students seem tobe doing at least as well as their seventh grade Non-CSMP counterparts, and often they do better. For example, interviews with seventh grade math teachers at one site confirmed the view that CSMP students had no difficulty adapting to the usual classroom activities of seventh grade, and were in some ways, better students.

VI. ISSUES/SUMMARY

From its inception, CSMP has been an ambitious undertaking. Even in the '60s and '70s, when innovation was encouraged, and liberally funded, CSMP's scope was larger than that of many other curriculum reform projects.

To summarize, the basic ingredients of CSMP's history are:

- a program with a unique point of view about elementary school mathematics
- Coordinators who received CSMP instruction and trained CSMP teachers who were observed and assisted by CSMP staff
- Students who received CSMP instruction, and whose progress in the program was evaluated over the entire development phase of CSMP's history
- Interested others: the school superintendents, schools boards, neighboring school districts, the mathematics and mathematics education community, and NIE personnel

Its uniqueness and complexity mean that implementing CSMP is no small undertaking. The developers created a complex package of training and training materials, as well as curriculum and curriculum materials. Each step in the implementation process, from selecting and training the Coordinator through assuring training for teachers and monitoring their use of CSMP in the classroom, is fraught with potential difficulties. In their major study of innovations, Berman and McLaughlin, et. al.[1], cited the need for innovations to be "mutually adaptable". In their view, the adaptation has to be specific enough so that the adopter knows what must be done and what is supposed to

[1] Berman, P., and McLaughlin, M.W. Federal Programs Supporting Educational Change. Vol. 1: A Model of Educational Change. Rand Corp., Ca., 1974.

happen; on the other hand, the innovation cannot be so rigidly conceived that it not able to be used over a wide range of school settings. On first glance, CSMP might fail on these counts. However, during our site visits we have seen many adaptations which lead us to believe the program can be tailored for the user and not lose its integrity as a program. In fact, the data suggest that sites that find the program appealing will work to make to a feasible adaption, and in the majority of cases where CSMP has been adopted, this strategy seems to have worked.

Site visits, interviews, questionnaires and test data show that the CSMP consumers who have managed to overcome the difficulties of adopting and implementing such a complex program have been pleased with its impact. Once the teachers have adjusted to the program, and adapted it to fit local needs, it has been well received. It has also benefitted students in participating school districts at all ability levels. Thus the program has had a demonstrable effect which earlier sections of this report have highlighted. In this section, rather than summarizing the data from the evaluations and site visits, a brief discussion of these constraints will be presented. Some constraints are rooted in the program itself, some are the result of local school district circumstances, and some reflect emerging national problems.

<u>Constraints rooted in the program</u>. Financially, the program costs adopting school systems in several ways. First, many of the materials are consummable. Therefore the program costs more to maintain than textbook programs and reordering is necessary <u>each</u> school year. As it is, the majority of Coordinators reported funding the materials cost out of their district's operating budget, a school's textbook fund or the principal's contingency fund. As the prices of materials continue to rise many Coordinators questionned if they would be able to continue the program in spite of the fiscal problems facing their districts.

The second program constraint is the need to have available a commited Coordinator for CSMP who has district-wide responsibilities and who has either a strong math background or a willingness to learn. Aside from the availability of such a person, there are concomitant costs associated with coordinating activities, the most serious of which is the need to train teachers, ideally for several days before the start of the school year. In fact, according to many Coordinators districts have a less critical problem purchasing the materials than they do continuing to fund the training. Since many districts no longer have paid in service days and since many teachers' unions have strict requirements about non-classroom time, the scheduling and funding of training will continue to be a major problem. A secondary problem for training is that many districts no longer have the fiscal discretion to hire large numbers of substitute teachers as a routine procedure. This prevents the use of weekday training sessions during the school year,when classes are in session.

A third constraint imposed by the program is the new knowledge and teaching style that teachers must be willing to take on. The new knowledge includes both mathematical content and lesson development and requires extra preparation, at least initially. The teaching style required by CSMP is different from what most teachers have grown used to: the lessons require more time devoted to teacher-led work, the spiral approach is new, there are few behavioral objectives and progress tests to monitor student progress are not part of the program. In additional the situational approach can be difficult to assimilate.

For some districts which have previewed the materials, the cost, in many cases, must have been sufficiently high for them to decide not to adopt CSMP. For other districts, which adopted the program briefly, the cost was high enough for them to decide to drop the program after a year or two of trial. Both the dollar cost <u>and</u> the human cost have contributed to many users' decisions to drop CSMP.

But for those commited districts, belief in the program far outweighs cost. Having chosen CSMP because it matches their idea of what ought to be taught in elementary schools, those districts are anxious to maintain the program, and even expand it, even in the face of today's fiscal debacle.

Local constraints. The type of student learning fostered by CSMP is quite different from the type of learning measured by standardized tests. In the current climate of accountability, many school districts must demonstrate positive effects. CSMP has no built in evaluation component for showing either program impact or short term student progress. Thus, school districts under accountability pressure must find appropriate evaluation measures, and administer them. Testing is costly in terms of dollars expended and student and teacher time needed especially when such testing would be in addition to the regular district achievement testing.

Few districts which adopted CSMP did more than look at the results of the yearly standardized testing program to assess CSMP's effect on students' performance. Districts which used CSMP for a Title I adoption or other specialized use also relied on standardized test scores. Most Coordinators, however, were well aware of, and concerned by, the need to show that CSMP students had satisfactory results on those tests. At some 30 sites, the Coordinators, concerned that standardized tests were not sensitive to the type of instruction provided by CSMP, elected to participate in the yearly MANS testing program conducted by MRES. The results were reported at the school, class and student level to the Coordinators. Those data provided the Coordinators with a measure of how well their districts' students were performing on tests of a problem solving nature, a better index of CSMP's impact. Sometimes the information was vital in making a continuation decision.

Another local factor which can cause problems for the program is the loss of a Coordinator, especially one who has been the central figure in CSMP's success at that site. Given the role which a Coordinator has been trained to play, conducting or supervising training, monitoring classrooms, as well as the strategies which Coordinators has acquired to juggle multiple responsibilities, the loss of a Coordinator may set a program back considerably. Similarly, the loss of well-trained, effective teacher advocates will signal trouble since many of those teachers have learned through classroom experience how to manage the program and teach it effectively. Without their guidance, other, less skilled or less experienced colleagues may not be inclined to devote the same attention to the program.

In addition to changes in local personnel, changes in policy in a district may also create problems for CSMP's implementation. A change in Superintendent may signal new curricula choices. Management by objectives might become a priority of a new administration or a new school board. Decisions to allocate dollars differently will affect the district's ability to purchase materials or conduct training at an adequate level. A call for competency-based testing on the part of state or local education officers will place the program in jeopardy. Teacher militancy may cause teachers to downplay the amount of extra-service time they've previously contributed to CSMP.

Issues in the national scene. Priorities have shifted so that education will not receive the share of the federal budget it once received. The result will be severe dislocations in districts' spending patterns. Title IV-B money will no longer be available for example and many programs will face severe cutbacks. It will be difficult for districts to justify expenses for one program which are not counterbalanced by expenditures for other programs viewed as equally worthwhile by their constituencies. Thus, schools will have to do more with less.

State and local testing program especially the competency based ones are likely to add further pressure towards standardization of the curriculum In addition, in the next few years, we can expect to see the same national public scrutiny of test scores which has been prominent in the press in the last few years. There will be the continuing scrutiny of pupil performance by NAEP and on the SAT. Programs must hold their own in fostering student achievement on these standardized measures.

Fiscal pressures will mean increased class size and low teacher morale stemming from fiscal cutbacks will be the loss of the more skilled teachers with marketable competencies. Math teachers may face increased pressure to leave the classroom and move to industry.The growing shortage of math teachers, which has already been noted, will prove to be a constraint for CSMP as well as other programs which call for advanced knowledge and skills.

On the bright side, is the nationally growing perception that mathematics needs to be emphasized in the curriculum, that more math and science teachers need to be trained. Here the trained corps of CSMP teachers constitute a force for renewal. Since a renewed national emphasis on teacher training will probably become a reality in the next few years, districts with CSMP teachers will be at a distinct advantage in taking a leadership role to promote higher level mathematics instruction in classrooms. The emphasis on training will also provide districts teaching CSMP but facing a dearth of mathematically sophisticated teachers with a newly trained pool of potential math specialists. This will bode well for CSMP since the lack of teachers with an advanced understanding of math has been one of the major drawbacks to the program's use at the upper grades.

Prospects for CSMP. One of the success stories of CSMP, aside from its demonstrable effect on students, has been the professional satisfaction teachers expressed about the program. They have perceived it to be a success, reported that it changed the way they think about mathematics and expect to be teaching it, or a variant of it, for many years. Their school systems regard CSMP as a necessary alternative to "back to basics" texts, and regard teacher commitment and student success as desirable outcomes for their investments. If CSMP support services disappear and are not renewed in some form, then many of those sites will bear a heavy burden in continuing to maintain the program at they level it needs to be maintained. Recent adopters or potential new adopters will have an especially difficult problem. But given the perceived need for an emphasis on mathematics at the national level, CSMP users are in the unique position of currently implementing a program whose time may finally have come.

Appendix A

CSMP References

*'MREL Bridging the Gap** This brochure describes the ıgrams and services available to clients in the CEMREL .ıon not only in mathematics, but in arts and humanities, in dia, in school learning and policy, and in general school provement as well. A special enclosure lists all educational oratories and research centers in the country — a valuable ource for you and your constituency.

*'MP for Compensatory Education** Although this collec-n of material is oriented toward CSMP usage, it can provide dents or teachers with appropriate goals for low achievers, propriate kinds of activities, and suitable organizational uctures for teaching such children.

*'MP for Gifted Students** These materials are analogous the compensatory education materials described earlier.

'MP in Action This manual consists largely of transcripts actual lessons used with both children and teachers. As ch, it illustrates CSMP's "pedagogy of situations" as a ching method and also exemplifies our "percolation ap-oach" to teacher in-service, namely, that teachers should ectly engage student lessons and materials.

aluation Report Series This series of longitudinal studies nsists of over 35 separate reports on student outcomes and teacher and student attitudes during and following com-tion of the K through 6 program. The reports cover the riod 1973 to the present and would be instructive for those erested in curriculum evaluation, evaluation design, sex d ability differences, test item construction, etc.

mstrip CSMP: A Problem-Solving Curriculum for the 80's This filmstrip discusses recent national assessment dings and recommendations by NCTM and by the NAEP nel. It also shows how CSMP provides for problem-solving lls, higher level cognitive skills, and expanded basics in the mentary curriculum.

*ANS (Mathematics Applied to Novel Situations) Test Infor-tion Packet** The MANS tests are a series of short test les designed to assess some of the underlying thinking lls of the CSMP curriculum. As such, they should be con-ered supplemental to conventional testing and geared vard assessment of expanded basics. Since they do not use y of the special languages or problems contained in CSMP, y are appropriate for use with any curriculum.

ıth Play Therapy This is a two-volume, two-year ount of special small group sessions with elementary dents who have had unhappy or difficult experiences in ıthematics and school and who are generally classified as low learners." The accounts contain descriptions of ac-ities and games successfully used to assist such students to come learners of mathematics. These volumes are useful pre-service clinical experience, illustrative of the case ıdy method, contributory to learning theory, and a source techniques for motivating the low achiever.

Minipackages These products provide mathematically rich activities from the CSMP curriculum, which can be taught by individuals with no prior CSMP training. Thus, an edu-cator could use these to maintain contact with schools (by providing teacher workshops or demonstration classes) or to make professional presentations. Students and teachers could add them to their resource ideas and activity files, and they are suitable for use during laboratory or field experi-ences. Current minipackages include descriptions of Mini-computer games and attribute games; a third product is under development.

*Preview Packet** This product consists of a glossary of CSMP pictorial languages, sample lessons from all strand areas and all grade levels, and representative student mate-rials — all built around problem solving as a theme. This packet is useful as a general resource on the topic of prob-lem solving as well as a free and representative sample of the curriculum.

"Regional Urban Needs, Successful Urban Practices, and the Comprehensive School Mathematics Program" This paper identifies mathematics needs of major urban school districts within CEMREL's 10-state region, lists successful urban practices from around the country, and discusses how the CSMP curriculum responds to such needs and compares to such practices. This paper is a valuable resource for educators concerned with improving the quality of mathematics educa-tion in urban settings.

Sample Sets of Instructional Materials At each grade level, a set includes the teacher's guide and one copy of each student workbook and worksheet. These sets constitute the minimum materials necessary for critical text analysis by students or teachers. They could also be used to illustrate all of the following: a unified curriculum, a spiral organization, higher level mathematics at the elementary level, a pedagogy of situations, ways of presenting mathematics to heterogeneous-ly grouped classes, and so forth.

Stories by Frédérique and the CSMP Library These series (one of stories, the other of story-workbooks) provide fan-ciful excursions into a colorful world of mathematics, actively involving readers in the acquisition of new mathematical in-sights. These materials are suitable for use by educators in workshop settings or by students and teachers in the classroom. They are particularly illustrative of CSMP's humanistic approach to mathematics education, its incor-poration of the child's fantasy world, and its use of situations and nonverbal languages. They exemplify materials that motivate children to reading in mathematics. These are an ex-cellent source of enrichment ideas.

*These items are available in single copies at no charge upon request. See the address on the back of this folder. Other items may be purchased using the Mathematics Publica-tions Catalog.

Armstrong, Richard D. "An Area Model for Solving Probability Problems." *Teaching Statistics and Probability — NCTM 1981 Yearbook*. Reston, VA: National Council of Teachers of Mathematics, 1981.

CSMP includes probability as an integral part of the elementary mathematics curriculum. The computational aspects of traditional arithmetic of complex multistage problems tend to obscure rather than illuminate underlying probabilistic concepts for the student. To avert this situation, CSMP has developed a geometric model for solving probability problems. The advantages of using a geometric model include the following: pictorial representations provide visual insights into the concepts of probability; reliances on geometric skills allow development of these concepts, which a lack of arithmetic skills would normally impede; less complex solutions are offered to sophisticated probability problems, division of regions in proportion to the appropriate probabilities appeals to students' intuitive understanding of probability.

Brown, Virginia. "Numbers Are Friends You Can Count On." *Early Years* 6, April 1976, pp. 50 — 53.

CSMP emphasizes that math can be an experience that allows students to tap their emotions and to utilize their aesthetic senses. An outstanding feature of the program is its use of nonverbal languages. The language of the Papy Minicomputer consists of a visual, hands-on device that allows children to work and think creatively about numbers and to carry out sophisticated math functions long before they are able to write numerals and to complete paper-and-pencil calculations. The language of strings brings into focus the important mathematical notion of set. Finally, the language of arrows is a graphic language in which colorful arrows shoot from dot to dot, indicating relationships. Dots may represent numbers, people, or objects. Arrows allow students to explore relationships without cumbersome notation or terminology.

Kaufman, Burt, et al. "Basic Mathematical Skills and Learning: The CSMP Viewpoint." *NIE Conference on Basic Mathematical Skills, Volume I: Contributed Position Papers*, 4 — 6, October 1975, Euclid, Ohio. pp. 98 — 105.

It is legitimate to identify skills related to learning mathematics and to acknowledge that a great many skills must be acquired in the process of learning mathematics. However, it is fatal to *equate* the process of learning mathematics with the acquisition of skills. Over-emphasizing the importance of the identification and acquisition of skills and excluding attention to the rest of the learning environment in which these skills are acquired lead to serious problems. The NIE should support research and development on the role of the hand-calculator and how to deal with the slower learner in the elementary mathematics classroom. Finally, consideration should be given to investigating the affective domain of learning and the learning of mathematics.

Kaufman, Burt A. and Haag, Vincent H. "New Math or Old Math? — The Wrong Question." *The Arithmetic Teacher* 24, April 1977, pp. 287 — 292.

Using a pedagogy of situations, CSMP stimulates intellectual involvement at all levels of mathematical sophistication. Examples are presented in the article that suggest children at all levels can be "turned on" by intellectual challenges, just as they are "turned off" by performing prescribed tasks to acquire skills. The elementary mathematics curriculum should give students exposure to what the discipline of mathematics is about — that is, to the knowledge of the kinds of problems mathematics can tackle, to the methods mathematics can apply to solve problems, and to the standards by which correctness in mathematical argumentation is judged.

Marshall, Karen K. "Thumbs Up Math." *American Education* 15, May 1979, pp. 33 — 36.

CSMP is directed toward students of all ability levels. The program emphasizes all ten mathematics basic skill areas identified by the National Council of Supervisors of Mathematics. CSMP uses a spiral approach to integrate mathematical concepts instead of dealing with just one concept for an extended period until all students understand. Its use of nonverbal languages helps children with limited reading skills to attain success. Calculators are used in the upper grades for problem solving rather than for computation. Those who teach CSMP need special training. Research indicates that although all students improve their mathematical abilities as measured on standardized and nonstandardized tests using CSMP, slower pupils make greater strides. In addition, students' attitudes toward mathematics improve.

Schneider, Joel, and Saunders, Kevin. "Pictorial Language in Problem Solving." *Problem Solving in School Mathematics — NCTM 1980 Yearbook*. Reston, VA: National Council of Teachers of Mathematics, 1980.

A major difficulty in teaching problem solving lies in having students record the details of a problem on paper. Their unwillingness to do this may stem from a resistance to the requirement that information in the word problem be translated into numerical expressions. An alternative approach is to provide pictorial languages whereby children can easily record information. Pictorial languages can permit individual freedom in approaching problems. As students develop, increasingly sophisticated problems and symbolic language may be introduced.

Shalaway, Linda. "Picking Up the Pieces After 'New Math.'" *Educational R & D Report* 3, Winter, 1980-81. pp 2 — 5.

CSMP believes children more readily learn mathematics in situations involving activities such as games, identifying a secret number, or building a number road that they consider worthy of attention. Along with problem solving, which is a major thrust, CSMP cultivates higher level cognitive skills such as estimation, reasoning, strategic thinking, and organizational ability. CSMP uses a spiral approach whereby children are exposed to different math topics every day, thus learning to look at mathematics as a unified whole rather than as a series of separate components. Specially developed tools, the nonverbal languages, help CSMP represent abstract math concepts in a graphic, complete fashion. Hand-held calculators are used as a tool to help students complete lengthy calculations when calculation is not the purpose of the lesson. To ensure that teachers are properly prepared, CSMP requires in-service training. Evaluations show CSMP students do as well as or better than non-CSMP students on tests of traditional math skills (including computation) and outperform them on measures of higher level cognitive abilities.

Miscellaneous Mathematics Publications

Adventures with Your Hand-Calculator by Lennart Rade and Burt Kaufman
The first section of the book poses twenty mathematical problems to be "solved" with the aid of a hand-calculator. . The second section of the book deals with further exploration and explanaton of the twenty problems, plus complete solutions to the problems.

The Teaching of Probability and Statistics at the Pre-College Level
ed. Lennart Rade. Included with this is "A Bioliography on the Teaching of Probability and Statistics." This book consists of the proceeding of the First CSMP International Conference co-sponsored by Southern Illinois University and CEMREL, Inc.

The Teaching of Geometry at the Pre-College Level
ed. Hans-George Steiner. This book consists of the proceedings of the Second CSMP International Conference co-sponsored by Southern Illinois University and CEMREL, Inc.

The Teaching of Algebra at the Pre-College Level
ed. W.E. Deskins and Peter Braunfeld. This book consists of the proceedings of the Third CSMP International Conference sponsored by CEMREL, Inc.

Papers Regarding the Managerial education vs. Humanistic Education Controversy*

"The Survival of Education" by Peter Hilton

"The Rhetoric and the Reality of Educational Change" by J. Myron Atkin

"Technology and Evaluation" by Ernest R. House

"The Mathematician's Responsibility to Education" by Gail S. Young

"Behavioral Objectives and Educational Decisions" by Robert M. Exner

"The Misuse of Educational Objectives" by Robert B. Davis

"Mismanagement by Objectives: A Learning Module for Planners in English" by Leo Ruth

"Mathematics Education--A Humanistic Viewpoint" by Peter Braunfeld, Burt Kaufman, and Vincent Haag

"Teacher Education and Teacher Training in Persxpective" by Gerald R. Rising

"Performance Criteria: Chopping Up the Teacher" by Gerald R. Rising

"A Plea for Continued Interest of Mathematicians in School Mathematics: by Robert M. Exner

"Some Thoughts About Behaviorism and Curriculum" by Gerald R. Rising and Burt Kaufman

"The Price of Productivity: Who Pays?" by Ernest R. House

"Professional Leadership and Performance Based Teacher Education" (PBTE) by J. Myron Atkin

What Behaviorism Has Done for American Education" by Edward C. Martin

"Michigan Association of Elementary School Principals Position Paper on Accountability in Education"

"A Case Against Managerial Principles in Education" by Peter Hilton

"Behaviorism: The Bane of School Mathematics" by Theordore A. Eisenberg

"What Do Your Child's Test Scores Tell You?" This is a reprint from the December, 1976 issue of Reader's Digest.

"The CSMP Approach to Curriculum Development," by Peter Braunfeld, Vincent Haág, and Burt Kaufman (St. Louis: CEMREL, Inc.)

"Happy Twentieth Birthday, Minicomputer," by Georges Papy (St. Louis: CEMREL, Inc., 1974)

"Minicomputer," Educational Studies in Mathematics, pp. 333-45 (Dordrecht: D. Reidel Publishing Company, No. 2, 1969)

"Minicomputer, Un ordinateur sans electronique," Media, No. 9, pp. 26-36 (Paris Institute Pedagogique Nationale, January, 1970)

On Papy's Minicomputer," by Peter Braunfeld (St. Louis: CEMREL,Inc. 1974)

"Papy's Minicomputer," Mathematics Teaching, No. 50, spring 1970

Summer School in the Old Days, CSMP (St. Louis: CEMREL, Inc. 1977)

"The Papy Minicomputer: A Didactical Analysis," by Peter Braunfeld (St. Louis: CEMREL, Inc., 1974)

*The first ten papers listed were published as a special issue of Educational Technology in November, 1973.

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Appendix B

MRES References

DATA SOURCES

IMPLEMENTATION REPORT

1. Evaluation Reports: Vols. 1-A-1 to 9-C-1
2. Site Visit Reports
3. Joint Research Studies
4. Coordinator Interviews
5. Principal Interviews
6. Teacher Interviews
7. Classroom Observations
8. MRES Adoption Records
9. CSMP Adoption Records
10. CSMP Publications and Reports

List of School Districts
Participating in MANS Testing

Ann Arbor, Michigan
Baltimore County, Maryland
Bedford, Michigan
Bronx, New York
Clarksville, Tennessee
Detroit, Michigan
District of Columbia
Ferguson-Florissant, Missouri
Gillette, Wyoming
Glendale, Wisconsin
Globe, Arizona
Grinnell, Iowa
Guilderland, New York
Harrisonville, Missouri
Hartsdale, New York
Hawaii Department of Education
Janesville, Wisconsin
Ladue, Missouri
Louisville, Kentucky
Madison, Wisconsin
Maplewood-Richmond Heights, Missouri
Marquette, Michigan
Mississippi State, Mississippi
New Hartford, New York
New Orleans, Louisiana
Normandy, Missouri
Philadelphia, Pennsylvania
Polk County, Georgia
Portland, Maine
San Felipe, New Mexico
St. Louis, Missouri
St. Louis Parochial, Missouri
University City, Missouri

Site	Year Adopted	Number of Years Adopted	Site Still A (1981-1982)	Type of Program	Grade Level First Year	Grade Level Latest Year/ Last Year	Historical Explanations	(Testing Data are Shown on a Separate Page) Data Available
Cities								Site Reports Interviews, Classroom Observations *Marks all other sites where these data have been collected
New Orleans, LA	1978-79	3	x	Title IVB	K-4	K-6		
Detroit, MI	1973-74	9			K-1	K-6		*
St. Louis, MO	1973-74	3 / /	x/	Regular Title I	K-1/1-5	K-3/1-5		*
New York City (Several Community Districts)	1979-80	3			K-1, 2	K-1, 2		*
Philadelphia, PA	1973-74	9			1	?		*
Washington, DC	1975-76	7			K-3	K-6		
Suburbs of Large Cities								
Oakland, CA	1977-78	2	x		K-3	K-4		
Affton, MO	1973-74	2	x		K	K		
Clayton, MO	1976-77	4	x		K-1	K-2		
Ferguson-Florissant, MO	1973-74	9			K-1	K-2		
Francis-Howell, MO	1973-74	2	x		1	1-2		*
Ladue, MO	1973-74	9			K-1	K-6		*
Maplewood-Richmond Hgts, MO	1977-78	3	x		4	K-6		*
Normandy, MO	1973-74	8	x		K-1	K-6		*
St. Charles, MO	1979-80	3		Gifted Pull-Out	2-5	2-7		*

Site	Year Adopted	Number of Years Adopted	Site Still A (1981-1982)	Type of Program	Grade Level First Year	Grade Level Latest Year/ Last Year	Historical Explanations	Data Available
Suburbs (cont)								
University City, MO	1975-76	7			K-3	K-6		*
Baltimore County, MD	1976-77	6			K-1	K-6		*
Montgomery County, MD	1978-79	4			1-3	1-4		*
Bloomfield Hills, MI	1980-81	2		Limited Pilot	K-5	K-5		*
Dearborn, MI	1981-82	1			K-3	K-3		*
Greenburgh, NY	1976-77	6			1-2	K-4	Voluntary in one school/ Mandated in one	*
Manhasset, NY	1981-82	1		Special Gifted	?	6 ?		*
Cleveland Hgts, OH	1981-82	1		Pull-Out Gifted	4-6	4-6		
Smaller Cities & County Districts								
Lowndes Co., AL	1980-81	2		Remedial Pull-Out				*
Globe, AZ	19							
Chandler, AZ	1980-81	2			K-3	1-2		*
Oakland, CA	1977-78	2	x		K-3	K-3		
Wisman, CA	1973-74	1	x		K	K		
Colorado Springs, CO	1980-81	2			K	K		

Site	Year Adopted	Number of Years Adopted	Site Still A (1981-1982)	Type of Program	Grade Level First Year	Grade Level Latest Year/ Last Year	Historical Explanations	Data Available
Smaller Cities & County Districts (cont.)								
Fort Collins, CO	1981-82	1		Special Gifted	?	?		
Catoosa Co., GA	1981-82	1		Jr. High L.D.	?	?		
Cherokee Co., GA	1976-77	6			1-3	1-3		
Gordon Co., GA	1975-76	1	x		K	K		
Harrison Co., GA	1975-76	2	x		1-3	1-4		
Polk Co., GA	1973-74	9			K-1	K-3		
Thomas Co., GA	1975-76	2	x		K-2	K-4		
Trion City, GA	1975-76	7		All Grades Taught by One Teacher	1-3	1-4		
Walker Co., GA	1974-75	8			K-2	K-6		
Hawaii	1979-80	3			K-3	K-6		
Herrin, IL	1973-74	2	x		K-1	K-1		
Pekin, IL	1979-80	3		Pull-Out Gifted	1-6	1-6		
Rockford, IL	1981-82	1		Upper Track	1-6	1-6		
Sesser, IL	1973-74	8	x		K-1	K-3		
Grinnell, IA	1980-81	2		Gifted Pull-Out	2-5	2-5		
Jeffersonville, IN	1979-80	3			K-3	K-3		

Site	Year Adopted	Number of Years Adopted	Site Still A (1981-1982)	Type of Program	Grade Level First Year	Grade level Latest Year/ Last Year	Historical Explanations	Data Available
Smaller Cities & County Districts (cont.)								
Greater Clark Co., IN.	1979-80	3						
Jefferson Co., KY	1979-80	3		"Gifted"	2-3	2-5		*
Elizabethtown, KY	1973-74	7	x		K-1	K-3		
Jeffersonville, KY	1979-80	2	x		K-3	2		
Marshall Co., KY	1980-81	2			K-1	K-1, 2, 3		
Fort Campbell, KY	1973-74	4	x		K-1	K		
Todd Co., KY (Elkton)	1975-76	4	x		1	1		
Portland, ME	1973-74	9			K-1	K-3		*
Ann Arbor, MI	1980-81	2			K-4	K-6		*
Autrain, MI	1974-75	6	x		K-1	K-1		
Baraga Township, MI	1979-80	3			K-3	K-4		
Bedford, MI	1979-80	3			1-2	K-3		*
Livonia, MI	1980-81	2			K-4	K-5		*
Matawan, MI	1981-82	1			1	1		
Marquette, MI	1978-79	4			K-2	K-3		*
Brainard, MN	1980-81	2		Gifted and Talented Pull-Out				
Mississippi	1980-81	2			1-3	1-2		*
Harrisonville, MO	1980-81	2		Gifted Pull-Out		1-6		

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Site	Year Adopted	Number of Years Adopted	Site Still A (1981-1982)	Type of Program	Grade Level First Year	Grade Level Latest Year/ Last Year	Historical Explanations	Data Available
Smaller Cities & County Districts (cont)								
Guilderland, NY	1980-81	2			K-3	K-4		*
New Hartford, NY	1973-74	9			K-1	K-6		*
Sodus, NY	1981-82	1			4	4		
Long Branch, NJ	1981-82	1			3-5	3-5		
Middletown, NJ	1973-74	1	x		K	K		
Asheboro, NC	1980-81	2			K	K		
Albuerque, NM	1980-81	2		Remedial Pull-Out	2-5	?		*
Alamo, NM	1979-80	3			K-3	K-3		*
Bethlehem, PA	1973-74	3	x		K-1	K-1		
Cal. State College, PA	1973-74	2	x		K-1	K-1		
Carlisle, PA	1975-76	1	x		K-1	K-1		
Central Green, PA	1975-76	1	x		K	K		
Lancaster, PA	1975-76	1	x		K	K		
No. Allegheny, PA	1973-74	4	x		K	K		
Shippensburgh, PA	1973-74	9			K-1	K-3		
Nashville, TN	1973-74	2	x		K-1	K-2		
Ashland City, TN	1980-81	2			K-1	K-2		
Montgomery, TN	1973-74	9			K-1	K-2		
Cheatham, TN								

Site Smaller Cities & County Districts (cont.)	Year Adopted	Number of Years Adopted	Site Still A (1981-1982)	Type of Program	Grade Level First Year	Grade Level Latest Year/ Last Year	Historical Explanations	Data Available
Jackson Co., TN								
Lincoln Co., TN	1973-74	2	x		K-1			
Houston Co., TN	1974-75	2	x		K-1	K-2		
Stewart Co., TN	1975-76	2	x		K-1	K-1		
Andrews, TX	1973-74	1	x		K-2	K		
Austin, TX	1973-74	2	x		K-1	K-2		
Conroe, TX	1981-82	1			4-6	4-6		
Ennis, TX	1976-77	8			1-3	1-2		
Royce, TX	1975-76	1	x		K	K		
Norfolk, VA	1978-79	4		Gifted & Talent Pull-Out	?	?		
South Burlington, VT	1981-82	1			2	2		
Federal Way, WA	1979-80	3		Pull-Out Remedial	2-6	2-6		
Port Townsend, WA	1979-80	3		Remedial Pull-Out	?	?		
Woodland, WA	1979-80	2	x	Remedial Assistance	2-6	2-6		
Glendale River Hills, WI	1978-79	4			3	K-3		*
Janesville, WI	1980-81	2			K-6	K-6		*
Madison, WI	1979-80	3			K-5	K-5		*

Site Smaller Cities & County Districts (cont.)	Year Adopted	Number of Years Adopted	Site Still A (1981-1982)	Type of Program	Grade Level First Year	Grade Level Latest Year/ Last Year	Historical Explanations	Data Available
Campbell Co., WY	1979-80	3			K-2	K-2		*
Fremont Co., WY	1976-77	6			K-4	K-6		
Private/Parochial Schools								
St. Mary's, AZ	1980-81	2			K-3	K		
Rhoades, CA	1981-82	1	x		1	1		
3-R School, CA	1981-82	1			1-4	1-4		
Gulliver Acad., FL	1974-75	1	x		K-1	K-1		
Carbondale, IL	1975-76	1	x		K-3	K-3		*
Sacred Heart, LA	1977-78	5			1-3	K-4		
Waynfelt, ME	1981-82	1			K	K		
St. Michael's, MI	1973-74	9			K-1	K-6		*
Bishop Baraga, MI	1980-81	2			K	K		*
Hebrew Acad., MI	1981-82	1			K-4	K-4		
Archdiocese of St. Louis MO	1976-77	6		CSMP Pilot Site	1-4	K-6		*
College School, MO	1978-79	4			K-5	K-6		
Ellisville, MO	1979-80	3			K	K-1		
Epstein Acad., MO	1976-77	3	x		K	K		
Joint Pre-School, MO	1979-80	3			K	K		

Site	Year Adopted	Number of Years Adopted	Site Still A (1981-1982)	Type of Program	Grade Level First Year	Grade Level Latest Year/ Last Year	Historical Explanations	Data Available
Private/Parochial Schools (cont)								
Notre Dame, MO	1981-82	1			K-2	K-2		
New City School, MO	1981-82	1			K-2	K-2		
St. Joseph's, MO	1979-80	3			1	K-2		
Solomon Schechter, MO	1981-82	1			K-1	K-1		
Forsyth, NC	1981-82	1			K-1	K-1		
Great Falls, NH	1981-82	1			2-3	2-3		
Buffalo College Lab	1977-78	5			K-4	K-5		*
Village Pre-School, NY	1979-80	2	x		4	4-6		
Richmond	1980-81	2			K	K		
Hunter College, NY	1979-80	3			K-1	K-3		
Santa Clara, NM	1980-81	2			K-1	K		*
San Felpe, NM	1979-80	3			K-1	K-3		*
Tenn. Tech Univ., TN	1973-74	2	x		K-1	K-1		
Clarksville Academy, TN	1974-75	8			1	K-3		
El Paso DS, TX	1981-82	1			K-1	K-1		
The Oaks, TX	1981-82	1			K-5	K-5		
Central Wash State Col., WA	1973-74	1	x		K-1	K-1		
Saskatoon, CA	1981-82				1-2	1-2		

Appendix C

Evaluation Panel

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Evaluation Panel

Ernest House (Chairman), University of Illinois

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